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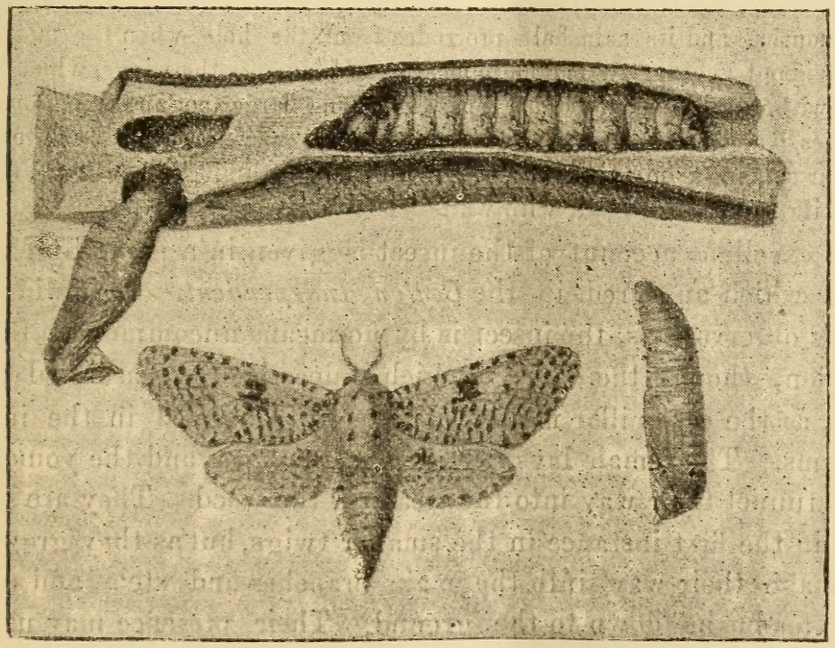
MISCELLANEOUS NOTES.

By E. C. Cotes, *Offg. Deputy Superintendent, Indian Museum.*

Boring insects in sandal wood and tea stems.

A good deal of damage is said to have been done in 1891 to young sandal wood (*Santalum album*) trees in Mysore by a boring insect. According to a report, dated 13th July 1891, by the Assistant Conservator of Forests, Mysore, furnished through the Director of the Dehra Dun Forest School, this borer attacks both the stem and the roots, either killing the sapling outright or weakening it, so that it is liable to get blown over by the wind. Sandal wood yields an important revenue to the Mysore State, so that any damage done to the young trees is of consequence.

The insect that seems to be chiefly responsible for the damage is the caterpillar of the moth *Zeuzera coffeæ* Nietner, a species which occasionally attacks both coffee (*Coffea arabica*) and tea (*Camellia theifera*) bushes.



Some Coleopterous larvæ, however, which appear to be *Tenebrionidæ*, have also been received, but are not thought likely to have played more than a subordinate part in injuring the sandal wood saplings. The identity of the insect was made out from a moth which emerged in the Museum, on 9th February 1892, from some affected sandal wood stems that were kindly furnished by Mr. J. Cameron, Superintendent of the Government Gardens, Bangalore. The only suggestion that could be made for dealing with the insect was to cut out and burn the infested stems and thus prevent the spreading of the pest. The figure shows the various stages of the *Zeuzera* with a piece of wood bored by it, all natural size.

A very closely allied or identical caterpillar was sent to the Museum in March 1891 by Messrs. Andrew Yule & Co., with the information that it had been doing a good deal of damage to the stems of tea (*Camellia theifera*) bushes in the Jorhat district of Assam.

The species *Zeuzera coffeæ* is figured and described in Moore's Lepidoptera of Ceylon, page 154, pl. 143, fig. 1. It was originally described by Nietner in his pamphlet on the enemies of the coffee tree in Ceylon, in 1861.

The following is an extract from Mr. Green's edition of Nietner's pamphlet, page 14—

"This insect.....destroys many trees, young and old, the caterpillar eating out the heart: for this purpose it generally enters the tree six or twelve inches from the ground, ascending upwards. Fortunately it is not abundant. It resembles the caterpillar of the goat-moth of England, is two inches long, and as thick as a goose-quill, nearly naked, of yellowish colour, back red, head thoracic and anal plates blackish; when full-grown the colours are light and dirty. The sickly, drooping foilage, and a heap of globules of conglomerated wood-dust at the foot of a tree soon indicate that the caterpillar is carrying on its destructive work inside. The chrysalis rests three months, and its skin half protrudes from the hole when the moth escapes, which is about February. The moth measures $1\frac{3}{4}$" across the wings, which are white, spotted with steel blue; the upper ones, with one large spot and numerous series of small ones, placed in rows between the nerves; the lower wings are less spotted. Thorax with four spots near margin. Abdomen variegated with blue. Legs blue, second pair with white femora, third pair with white femora and tibiæ."

An excellent account of the insect is given in a paper by Mr. E. E. Green, which appeared in the *Ceylon Independent*. According to Mr Green's observations, the insect is by no means uncommon on tea estates in Ceylon, though the damage which it does is often ascribed to other causes, as the caterpillar is very completely concealed in the interior of the stems. The female lays her eggs in the bark, and the young caterpillars tunnel their way into the heart of the wood. They are generally found in the first instance in the smaller twigs, but as they grow bigger, they make their way into the main branches and stem, and often kill young tea bushes down to the ground. Their presence may usually be detected by the heaps of sawdust-like excrement to be found on the ground under the bush. Mr. Green notices that according to his own observations the moth does not emerge at any one particular time of the year.

Tea defoliator in Jorhat.

In April 1891 specimens were furnished by Messrs. Andrew Yule & Co. of an insect which had proved destructive to tea (*Camellia theifera*) in the Jorhat district of Assam. The manager of one of the gardens wrote that he had been getting 25 two-maund bags of these caterpillars picked off the bushes

daily, but that in spite of all his efforts they seemed rather to increase in numbers. They stripped the leaves and the bark off the bushes to such an extent as in some cases to kill the plants. The manager added that during the ten years he had been in the district he had never seen such a visitation, and that his coolie sirdars, some of whom had been over 20 years on the garden, could not remember the like. The specimens that were forwarded were found to be the larvæ of a Bombyces moth which is thought to belong to the family Arctiidæ. The insect does not appear to have been previously sent to the Museum as attacking tea, and it cannot be identified precisely without an examination of the moth into which the caterpillar transforms. The fact that it has not previously been reported as attacking tea makes it pretty certain that it is not a species likely to do any very extensive injury. To enable the moth to be reared for identification in the Museum it would be desirable to obtain some live full-grown caterpillars or better chrysalids. They would probably reach Calcutta alive if they were lightly packed with a few tea shoots and sent direct in a perforated box or basket. The caterpillar could no doubt be easily destroyed by spraying the tea bushes with an insecticide, but this method of treatment does not seem to be generally looked upon favourably by tea planters, and it is very doubtful to what extent it would be desirable in the present instance, on account of the poisonous nature of most of the preparations.

White grub in Sikkim.

In October 1891 a number of Melolonthidæ larvæ (=*cockchafers* or *white grubs*) were forwarded to the Museum by Messrs. Davenport & Co., with the information that they had appeared in vast numbers in some of the hill tea (*Camellia theifera*) gardens, and were making great havoc among the young tea plants. In one case the insect was said to have practically destroyed 100 acres of young tea as fast as it was planted. The prevalence of the pest was attributed to the abnormally dry weather. An attempt was made to rear the insect in the Museum for precise identification, and in February 1892 a mature specimen emerged in the rearing cage. It was found to be identical with a species which was determined some years ago through Dr. Günther as *Lachnosterna impressa* Burmeister. It is therefore the insect which appeared in vast numbers and proved very destructive in Darjeeling in the year 1883. In Ceylon coffee estates, where allied insects proved very destructive about a dozen years ago, the only method of treatment that was at all successful was digging out the grubs by hand, and this, though very costly, was generally admitted to be the most satisfactory method of dealing with the pest. Attempts have recently been made in Europe to destroy *white grubs* by innoculat-

ing them with the spores of a fungoid disease to which they are subject. This method of treatment however has not yet passed beyond the experimental stage, so it cannot be recommended for practical purposes. In the case of a species which attacks the roots of vines in Europe, bisulphide of carbon has been recommended, and this chemical seems likely to prove of practical utility. The simplest method of treatment was to make a hole near the main root of the vine by forcing a small stick into the earth, then to pour about half a teaspoonful of bisulphide of carbon into the hole, and plug it tightly with earth pressed down by the foot; and more elaborate methods which are said to have been successfully adopted in French vineyards for fighting phylloxera with bisulphide of carbon would no doubt be equally effective for dealing with white grub in Sikkim. According to Mayet (Insectes de la vigne 1890), as quoted in a recent report by Mr. Charles Whitehead: "the bisulphide is put into the ground in two or three holes close round the roots of each vine, with a kind of hand pump (*pal*) terminating in a tube with a short point having an orifice near its end. This is thrust into the earth, and the liquid is forced into the hole by pressure from the pump."

Cask borers in India.

The damage done to beer casks in India by minute beetles which drill holes into the staves, has attracted a good deal of attention during the past few years. Mr. W. F. H. Blandford, F. E. S., Lecturer on Entomology at the Indian Civil Engineering College, Cooper's Hill, has for some time been investigating the subject, and asks for co-operation in procuring further information.

The subject is a complicated one, as the casks are attacked by several distinct insects, some of which are more destructive than the others. In the case of the casks dealt with in an interesting report by Mr. Blandford, which appeared in the Bulletin of Miscellaneous Information, Royal Gardens, Kew (September 1890), the damage was attributed to a Scolytid of the genus *Trypodendron*—species *domesticum* Linn, also *signatum* Fabr.-*quercus* Eich. These insects are natives of Europe, where they attack newly felled timber. From this, and also the fact that some of the holes in the casks examined were found to be covered up by iron cask hoops, which fitted so tightly that it was quite impossible for the insect to have begun to bore after the hoops were put on, Mr. Blandford concluded that the cask was attacked before ever it was filled with beer and shipped. In the case of a further consignment, however, afterwards received, the damage appears to have been done either on board ship or in India by a Scolytid of the genus *Xyleborus*. The species *Xyleborus perforans* Wollast. was the one recognised by Mr. Blandford; it is no doubt the same insect as the cask borer from Rangoon, referred to in the Proceedings of the Entomological Society of London, 1882, p. xvi, as

Xyleborus saxeseni Ratz. and it is thought to be the one that does most of the damage to the casks.

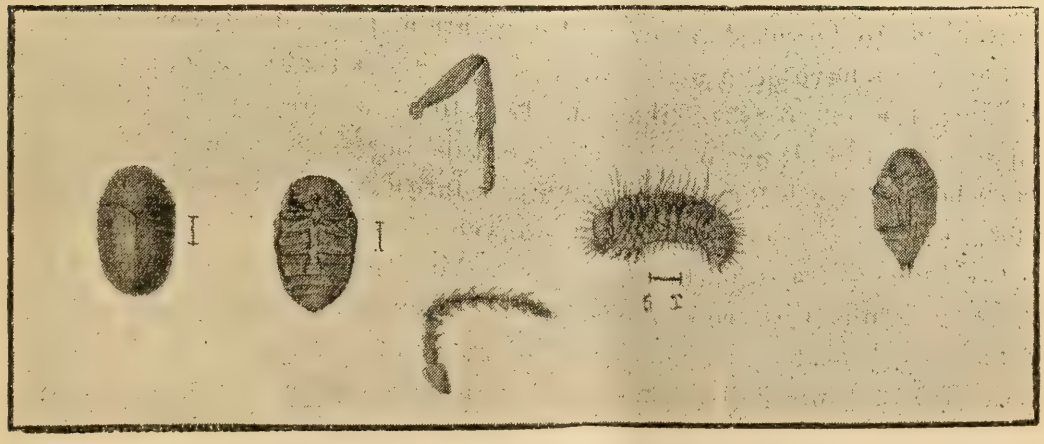
The *Xyleborus* beetles, which attack stored casks, can be easily distinguished from the *Tripodendron* beetles, which attack green wood, by the fact that the *Xyleborus* is very much smaller than the *Tripodendron* (3 mil. long by 1 mil. broad, against 4 mil. long by 2 mil. broad), and also by the shape of the burrow, which in the *Xyleborus* branches a good deal, while in the *Tripodendron* the straight tunnel made by the parent has only a number of little chambers eaten out around it by the larvæ.

The above is a sketch of the question as it stands at present, but several of the points are still uncertain, and as it is obviously of importance to determine whether the damage is due to original unsoundness in the casks or to subsequent injury in store, Mr. Blandford is taking up the whole question and collecting information with a view to settling it definitely. He will be grateful for any help that is given him in the matter, and writes that the chief points upon which he requires information are: (1) if the barrels are attacked on board ship, or in transport, or in store: (2) whether the beetle is confined to beer casks or also attacks other timber: (3) any particulars about the life history of the insect and the extent to which it gives trouble in Indian breweries.

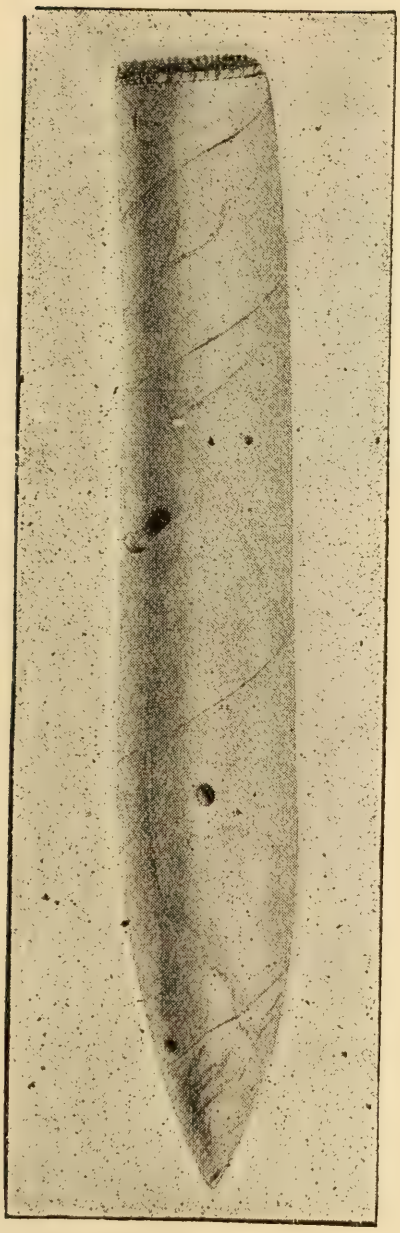
Postscript.—Mr. H. M. Phipson of Bombay writes—(January 1892), that the Inspectors at the Commissariat office in Bombay all say that of late they have not been troubled with the borer. They agree that two or three years ago, when so many of the casks were attacked, the casks were in the majority of cases found to be leaking, on being landed, so it would appear that the insect commences its operations on board ship.

Cheroot borer.

In the rainy season of 1891 attention was again called to the "cheroot weevil," *Lasioderma testaceum* Redtenb. (Dermestidæ). This insect drills the



small round holes which are so often met with in Indian cheroots, and



is said to interfere very seriously with the exportation of Indian cheroots. So far as is known the beetle lays its eggs on the leaf, and the little curved white hairy grubs, which emerge from these eggs, tunnel their way through the tobacco, and finally transform into white motionless pupæ from which the beetles emerge ready to cut their way out of the cheroot, and thus form the round holes which are so characteristic a sign of the presence of the insect. The length of time spent by the insect in its various stages has not yet been traced, and there is still a good deal of doubt as to the stage in the manufacture at which the eggs are usually laid. In some old broken-up cheroots, kindly furnished by Mr. G. W. L. Caine, in August 1891, were found both some very young larvæ and also two minute eggs which were thought to belong to this species. The eggs were transparent-white in colour, showing the yolk cells by transmitted light. They were oval in shape, with a number of minute protuberances at one pole, and they measured, one of them, about a fifth, and the other about a third of a millimetre in length. They were found loose amongst the broken pieces of tobacco leaf. The eggs were evidently alive when found, and their presence in the old cheroots goes to show that eggs are at least sometimes laid after the cheroots have been matured. This indicates that care in packing and storing the cheroots is likely to tend to reduce injury by the insect, though it would not of course prevent damage in cases where eggs had been laid on the leaf before it was made into cheroots. It was suggested that, subjecting the cheroots to a temperature of 80 or 90 degrees centigrade for a few hours before packing, might serve to destroy any eggs or grubs they contained. This treatment, however, was found to injure the flavour of the cheroots, so could not be recommended. Upon the whole, the most likely means of reducing damage by the weevil seem to be—firstly, to keep the leaf, during the process of its manufacture, as much as possible out of the way of old cheroots and refuse tobacco of

all kinds where the insect is likely to breed; and, secondly, to pack the cheroots in as air-tight a manner as possible, so as to prevent the mother beetles getting into the boxes to lay their eggs. The insect is known to attack stored rice, opium, and other vegetable substances, as well as tobacco, so the cleaning up of the manufactory should be as thorough as possible. The figures show the various stages of the insect, also a cheroot tunnelled by it. The size of the insect is indicated by hair lines.

Cocoanut blight.

In May 1891 specimens of scale insects, destructive to cocoanut trees in the Laccadive Islands, were forwarded to the Museum by Mr. Edgar Thurston, who had received them from Mr. W. Dumergne. Mr. Dumergne found the cocoanut (*Cocos nucifera*) trees at Aucutta attacked by what was thought to be a disease. Some years previously the same disease was said to have carried off thousands of trees in the Laccadives, thus seriously damaging almost the only product of these islands. Mr. Dumergne was told that the first symptom of the disease had been an army of ants. The leaves, when attacked, were said to turn a sickly brownish-yellow and gradually shrivel up, the tree itself succumbing altogether in a very short space of time.

The leaves furnished were found to be thickly beset with Coccidæ (scale insects) which would be quite sufficient to account for the injury reported. The ants no doubt merely attend the Coccidæ for the sake of the secretion yielded to them by so many species of this group of insects, and they have therefore nothing to do with the injury to the cocoanut trees.

With regard to remedies, the most successful method of destroying scale insects on trees is generally agreed to consist in spraying them with the kerosine and soap emulsions described in earlier numbers of these *Notes*. It is difficult, however, to say to what extent such treatment would be practicable in the present instance; especially as experiments, recently made in the United States, have shown the extreme difficulty in completely eradicating scale insects from palm trees, on account of the large amount of shelter which is afforded to the insects in the crevices between the folds of the leaves.

With a view to obtaining the identification of the scale insect concerned, the specimens were submitted to Mr. W. M. Maskell, who has kindly examined them and furnished an interesting note upon the subject. Mr. Maskell found that the leaves were infested by two distinct insects belonging to two different genera—Dactylopius and Aspidiotus. The former, in which each insect has white cotony secretion is so near to *Dactylopius cocotis* Maskell, that Mr. Maskell considers it identical or at most a variety (see p. 66). The latter was found by Mr. Maskell to be undoubtedly *Aspidiotus destructor* Signoret, in which a distinguishing character is the comparative smallness of the two

median abdominal lobes in the female. This insect is stated by Signoret to have been dreadfully injurious to cocoanut trees in the Isle de la Réunion.[1] For further particulars see p. 66.

Wheat-stalk borer.

In January 1892 the Superintendent, Government Farms, Nagpur, forwarded wheat (*Triticum sativum*) leaves from fields which were said to be suffering to a very large extent from some disease or insect attack. Little could be made of the specimens, though the remains of a number of minute creatures which appeared to be Collembola (order Thysanura) were found upon the leaves. These insects were not thought to be sufficient to occasion the damage that was reported. In February, however, a number of green wheat stalks were forwarded. These had their stems tunnelled by the caterpillars of a Microlepidopterous moth, either identical with, or very closely allied to, the paddy borer *Chilo sp.* described on page 19 of Volume II of these *Notes*, as attacking paddy in the Bombay Presidency.

A series of specimens, illustrative of the same wheat borer, were forwarded by Mr. Mollison, Superintendent of Farms in the Bombay Presidency. According to an interesting note by Mr. Mollison, dated 23rd February, a considerable amount of damage had been done by the insect in experimental plots of wheat on the Government Farm, Poona. The caterpillars were found inside the stalk, usually in the hollow of the straw above the node nearest to the ear. The first symptom of attack that was noticed was a bleaching of the ear and stalk down to the point where the caterpillar was at work, while the lower part of the plant remained green and healthy. Several varieties of wheat were being experimented with in small adjacent plots, and one plot of wheat that ripened sooner than the other was not affected, while none of the plants were noticed as attacked until they were within it about ten days of ripening. The wheat followed green peas, and the wheat seed from which these plants were raised had been grown on the farm the preceding year. The specimens arrived in excellent condition, the caterpillars reaching the Museum alive, so it is hoped to rear this moth for identification. It will be interesting to ascertain whether this paddy borer, which attacks the rice crop in the rainy season, is the same as the caterpillar which attacks wheat in the cold weather. In the case of the paddy borer, which did some damage in the Bombay Presidency last year, there was reason to suppose that the insect passed through a number of generations in the course of the year, hybernating in the self-sown paddy and large grasses, around the paddy

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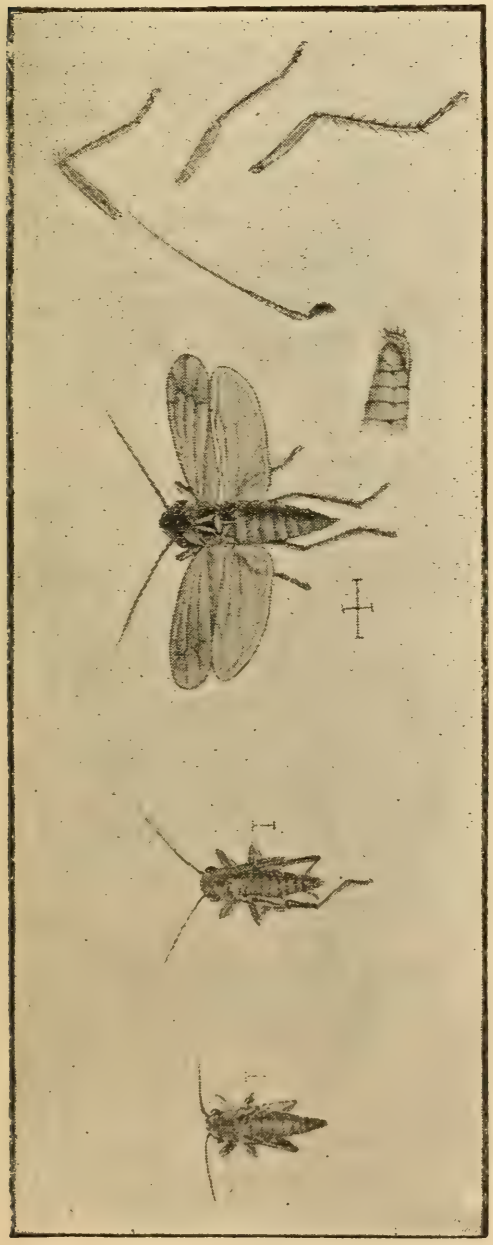
[1] The success which has attended the experiments made by the United States Entomological Department in importing *Vedalia* beetles (*Coccinellidæ*), at first from Australia into California, and afterwards from California into Egypt and New Zealand, for the destruction of the scale insect *Icerya*, would seem to indicate the desirability of ascertaining whether, in the Isle de la Réunion, the palm scale is attacked by any Coccinellid which might be worth importing into the Laccadives.

fields. It was therefore recommended to keep down the self-sown paddy and large grasses as much as possible, with a view to reducing the number of moths that would be liable to lay their eggs on the paddy crop. The efficiency, however, of such measures will obviously be much reduced if the wheat fields prove to be a breeding place of the insect. Even if this should turn out to be the case, however, the clearing of the fields during the hot weather, when neither wheat nor paddy are being grown, would seem likely to be useful.

Green fly tea blight.

A good deal of damage was done in the early part of the tea making season of 1891 in Assam by an insect which is known as the *green fly* or *blister blight*. Specimens were sent to the Museum from several gardens in Assam, and some were also obtained, through the courtesy of the Calcutta Agri.-Horticultural Society, from the Darjeeling tea district. The specimens from the different localities were all identical, and proved to belong to a species of leaf hopper which is included in the family Jassidae. The insect therefore is allied to the *Idiocerus niveosparsus*, Leth. which has previously been reported as injurious to mango (*Mangifera indica*) blossom in India. Specimens of the tea insect were sent to Mons. Lethierry of Lille for precise identification. Mons. Lithierry very kindly examined them and reports that they belong to the species *Chlorita flavescens* of Fabricius and Fieber. He adds that the insect is fairly common in Europe, and that he has also received specimens of it from Algeria, Brazil, and Siberia, so it may be looked upon as practically cosmopolitan.



From the accounts that have been received from Assam, it appears that the insect attacks the young tea shoots and sucks their

juices to such an extent as to stunt their growth and prevent their attaining anything like their natural size. It is also said to cause the white blister-like patches that are found on the more mature tea leaves. It is said to have done serious damage in tea gardens both in Cachar and in the Upper Assam valley. It appeared in the early part of the season, and (at least in the Upper Assam valley) is said only to have lasted until the middle or end of June. Cold damp seasons are thought to favour its increase. No remedy seems to have been found that was of any use. The insects were not attracted by lamp traps placed amongst the bushes, and were so active and difficult to catch that hand-picking was out of the question. Extra hoeing was adopted in one case with a view of increasing the vigour of the tea plants, and thus of helping them to throw off the blight, but it is not said whether this did any good.

According to a report, dated 19th June 1891, by Mr. G. F. Playfair of Cachar, kindly furnished through Messrs. Barry & Co., the insect stops the growth of the young shoots, and prevents their ever becoming fit for plucking. The effect of the pest was said to be deplorable. Over whole sections of the tea garden the plants were covered with leaf about an inch long, which never grew any bigger; and one case is cited where 199½ acres had been plucked, and had given considerably less leaf than had often been obtained from a patch of 17 acres. The only treatment that was tried was extra hoeing in the hope of bringing vigour to the bushes. The report adds—

"To bring the state of things before you in the most comprehensive manner I have pressed some shoots and send them by to-day's post, together with a little bottle containing about 100 of the insects which do, *or are supposed to do*, the damage. They are so active and difficult to catch that it took a boy a day-and-a-half to procure the specimens to send.....On one side of the sheet of paper, on which I have pasted the samples of shoots, you will find healthily grown leaves, ... purposely chosen, rather under than over the average as regards size, so as not to create a false impression, or make the comparison too striking. On the opposite side of the sheet are thrippy shoots of all kinds from the smallest to the largest, but also representing three leaves and the bud. Every one of these should have been as big or bigger than the healthy shoots, but I think the total weight of the sixteen former would not equal that of the three latter. A glance at the specimens will show you how impossible it is to make any outturn out of growth of this kind."

The following account of the blight by Mr. A. W. Madden of Dibrugarh, Assam, was published in the Proceedings of the Agri.-Horticultural Society of Calcutta :—

"Since receipt of your letter of 2nd May, I have been making farther enquiries about the blight. I find that a number of gardens are affected by it this season to a much severer extent than in previous years. I enclose a letter from one of my managers.

"At another garden a piece of pure Assam tea, which had been treated in the same way, was first affected, then the blight attacked a piece of tea next it very severely. The latter piece had been pruned into about 4-year old wood, and had new shoots up to a foot long, and many of these have died down completely."

Enclosure.—"I received the Horticultural Society's letter on the 14th instant, which I return. The blight first appears in round white blisters, about the size of a two-anna piece, on the under side of the leaf. In a few days these white blisters turn very dark, and expand over the greater part and often the whole of the leaf. When fairly started the darker blight, and not the white blisters, appears to spread over the rest of the bush, sometimes not only attacking the leaves, but the new stem, in which case the stem and leaves above the blighted part double over and eventually fall off.

"All the plots of the garden are now blighted, though in some plots there are only one or two bushes. The plot first blighted, and the surrounding ones, are much the worst.

"In January 1890 the bushes of the blighted plot were pruned down to 9 inches and lower; the prunings were buried in 3 feet trenches which had been cut 24 feet apart. In March it was double hoed, and during the year it was single hoed five times, and in December it was double hoed again. This season it was left unpruned. Since January this year it has been single hoed three times, and last month it was drained by cutting 3 feet drains 48 feet apart, running at right angles to the trenches cut the previous year.

"I forgot to mention that at the time the plot was pruned it was manured by putting one basket of cow manure to four bushes.

"In the first plot I think it is disappearing, but in the surrounding ones it appears to be still spreading. In the letter I sent you this morning I forgot to mention that we have noticed a large number of small green flies about the affected bushes. I send you by post to-day a small bottle containing some of the flies."

According to a report, dated 17th July 1891, kindly furnished by Messrs. Williamson, Magor & Co., of Calcutta, green fly blight had been very prevalent and persistent in its attacks on some gardens in Assam. On one estate open lamps were placed about the tea, but the manager reported that this experiment was a failure, for whereas myriads of other insects were attracted by the flame of the lamps, the green fly remained undisturbed under the tea leaves. The green fly was said to be less numerous and to do less harm in sunny dry weather than when it was wet and comparatively cold, but it seemed to require a good long spell of hot dry weather to cause any appreciable diminution in its ravages. The early part of the present season was unusually wet and cold in Assam, and this is thought to account for the prevalence of the blight.

It may be worth noticing that, in the case of the allied insect which attacks mango blossom, spraying the trees with the arsenical wash which is known as London purple, was tried with some success in the Saharunpur Botanical Gardens. Great care would of course be necessary in applying London purple wash to tea, on account of the poisonous nature of the substance; but in cases when a garden has been shut up by the blight, there would be no danger in trying it, provided no plucking at all

was done until after a new flush had appeared and the bushes had been well washed by rain. The Calcutta Agri.-Horticultural Society has undertaken to have experiments made upon the insect with some London purple that has been sent to the Museum by Messrs. Hemingway & Co., of London and New York, and some of the same insecticide has been furnished to Messrs. Barry & Co. for a similar purpose. The figure shows some of the stages of *Chlorita flavescens*, with much enlarged diagrams of the antenna legs, and terminal segments of abdomen of imago. The size of the insect is indicated by the hair lines

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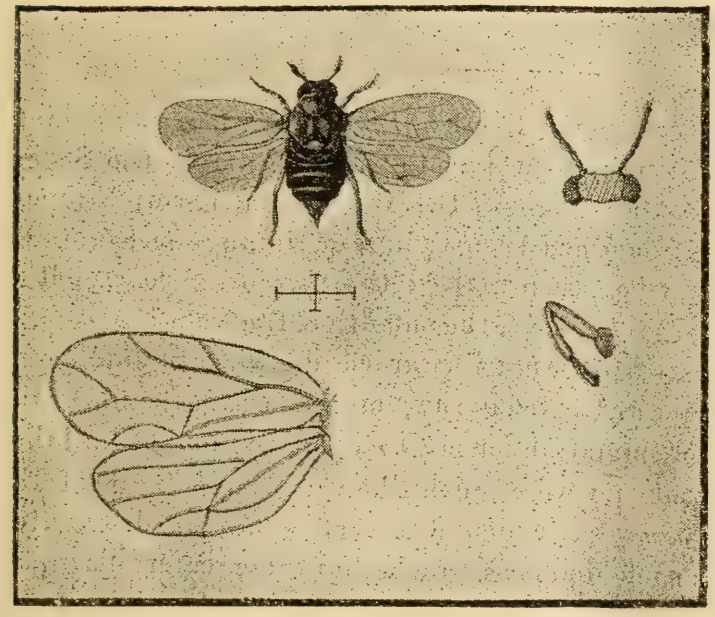
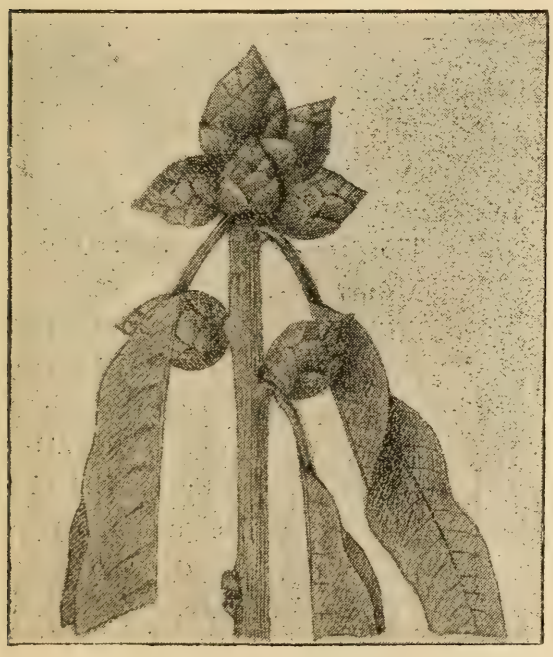
Opium weevil.

In the crop report, for the week ending 23rd December 1891, it is noted that the poppy (*Papaver somniferum*) sowings in Partabgarh (North-Western Provinces) had been attacked and considerably injured by beetles. About the same time numerous mature specimens of a small weevil, which is thought to be the insect referred to in the crop report, were received from Mr. J. Cockburn of Ghazipur. This insect appears to be a species of *Sitones*, but as it is unnamed in the Indian Museum collection, specimens have been sent to Mons. Desbrochers des Loges for favour of determination. In Ghazipur the insect was said to be very prevalent, and an instance was quoted where fields had to be sown three times over on account of the destruction caused by it to the young plants. It was found only to attack the seedlings for the first four or five days of their career, no damage being done after they had once attained a height of half an inch. Flooding the beds was not found effectual in destroying the pest, for the insects crawled on to the partition walls and thus escaped drowning. Hand-picking therefore was suggested by Mr. Cockburn as the most promising means of dealing with the evil. It may be noticed that spraying the young plants with an arsenical insecticide, such as London purple or Paris green, would probably be equally effective and less costly than the hand-picking. The figure shows the imago stage of the insect with much enlarged diagram of the antenna. The size of the insect is indicated by the hair line.

Mango Psylla.

In April 1891 the Director of the Forest School, Dehra Dun, forwarded blighted shoots of mango (*Mangifera indica*), with the information that the whole of the mango trees in a large garden near Dehra were attacked, though, strangely enough, other trees close by had not suffered. The blighted shoots were aborted, so as to appear almost like a series of little green rosebuds upon the twigs. These false buds were found to contain mature *Psyllidæ* (*i.e.*, minute fly-like Rhynchota allied to the Aphidæ). The insect has not previously been described from India, so it has been sent to Mr G. B. Buckton in England for determination. It is no doubt allied to the *Psylla buxi*, described in the year 1737 by Reaumur, as aborting the leaves of the box tree much in the way that this insect aborts the mango shoots (Reaumur Mem., p.351, pl. 29). With regard to remedies for the pest, any of the kerosine washes which are coming into use in the United States and Europe for destroying plant lice on fruit trees would no doubt also kill this insect, if it could be got at, but the insect is so much protected inside the aborted bud-like shoots that there seems little chance of reaching it with an insecticide. Insecticides might perhaps be useful for spraying the trees when the parent insects are engaged in laying their eggs, but it has still to be ascertained at what time of the year this takes place—whether in the spring or autumn. Clearing up rubbish around the mango trees, where the insects are likely





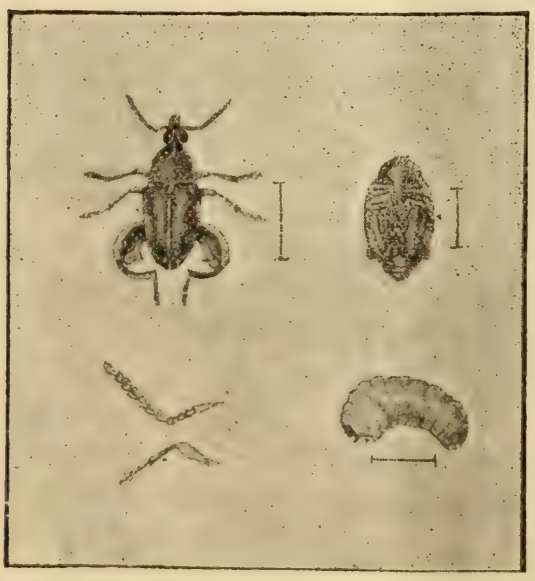
to shelter themselves, picking off and burning the affected shoots, and white-washing the trunks, might also be of some use, but as yet too little is known about the insect to warrant any very definite suggestions for dealing with it. The figures show the winged insect, with much enlarged diagrams of the wings, head and one of the legs, also the end of a mango twig with aborted shoots. The size of the insect is indicated by the hair line.

Linseed caterpillars in Nagpur.

In November 1891 some young linseed (*Linum usitatissimum*) plants were forwarded to the Museum by the Superintendent of the Government Farm, Nagpur, with the information that they had been dying off in an unaccountable manner. A similar blight had been noticed the preceding year, and in some fields had very materially reduced the outturn of the crop. A careful examination of the plants that were forwarded disclosed a number of minute caterpillars which were located in the young shoots at the top of the plants. They were far too immature for precise identification, and all that could be made out was that they were much like very young larvæ of the Noctues moth *Heliothis armigera*, which is a very generally distributed pest in India. There is some doubt as to whether these caterpillars are sufficient to account for the dying off of the plants. The insect could no doubt be easily destroyed by spraying the plants with almost any insecticide, though this is a form of treatment which has not yet been much adopted in India.

Tamarind Bruchid.

From the Secretary to the Agri.-Horticultural Society of India were received (6th July 1891) specimens in different stages of development of a Bruchid which attacks the seed of the Tamarind tree (*Tamarindus indica*) in Calcutta.



The insect was submitted to Mons. A. Fauvel, who has kindly examined it and reports that it belongs to the species *Caryoborus* (*Bruchus*) *gonagra*.[1] Fabr. M. Fauvel calls attention to a paper by H. L. Elditt, entitled "Die metamorphose des *Caryoborus* (*Bruchus*) *gonagra* F." Gratulationschr. der Phys. Œk. Gesellsch. H. Rathke, Königsberg, 1860, dealing with this insect. This paper is not to be found in

[1] This is probably the insect referred to by Dr. H. Cleghorn (Journ. Agri-Hort. Soc., India, Vol. XIV, p. 294, 1867), as infecting tamarind seed.

Calcutta, but an attempt will be made to procure it from Europe. In the meantime it may be noticed that the seeds of almost all leguminous plants are subject to the attack of Bruchidæ beetles belonging to some one of the numerous species of this group of insects. The beetle generally lays its eggs in the immature pod, and the larvæ, which are little white legless grubs, tunnel into the seed where they pass their lives, finally transforming into motionless pupæ from which the beetles emerge ready to copulate and lay eggs of their own.

Postscript.—A copy of Elditt's paper has since been procured. Elditt found the insect, in the three stages of larva, pupæ, and imago, in pods of *Cassia fistula* (the Indian Laburnum) which he obtained from apothecaries' shops in Königsberg. After carefully describing the insect in its various stages, Elditt gives an interesting account of the parts of its life history he was able to ascertain. With regard to the egg laying he was not able to make any observations but concluded the insect was likely to have the same habits as the common *Bruchus pisi*. It would therefore lay its eggs in the pods before they reached maturity, and the beetle would be a native of the same country as the tree. Upon the whole he thought that the insect was likely to be a native of the East Indies. He found that the larvæ made its way through the pod and tunnelled directly into the seed; a seed was only big enough to afford nourishment for one grub, and Elditt found that none of the seeds were attacked by more than one grub, though he was unable to explain how this came about. Each seed was enclosed in a chamber with partitions of the shell separating it from the seed on either side of it, and the grub seemed in no case either to have attacked a seed that was already tenanted, or to have tunnelled through the partition walls of the chamber to enable it to pass from a tenanted seed to one as yet unoccupied. When full fed the grub left the seed and spun a close matted cocoon for itself inside the pod. The beetle, after emerging from the pupal skin, rested a considerable time before cutting its way through the cocoon and the wall of the pod, both of which have to be perforated before it can effect its escape. Elditt supposed this period of rest to be a natural feature in the development, serving to give the integument of the beetle time to harden, but it seems more likely that it was a mere accident due to the fall of temperature owing to transporting the insect from a tropical climate into a temperate one. The time passed by the insect in its various stages was not observed. From the paucity of the specimens that he was able to procure, and from the absence of complaint on the subject amongst the druggists he consulted, Elditt concluded that the injury done by the insect to Cassia pods is insignificant. The figure shows the various stages of the insect, also much enlarged diagrams of the antenna and one of the legs of the imago. The size of the creature is indicated by hair lines.

Cut-worms.

Writing from Bahraich, Oudh, on 23rd March 1891, Mr. J. Cockburn notes that he had observed moths of both *Agrotis suffusa* and *Ochropleura flammatra*, which are destructive cut-worms of the rabi and other crops. He noticed them from the 1st November up to the time he wrote, when their numbers were specially great. He added that they had been doing serious damage in the Sultanpore and Bahraich districts, five per cent. of the produce over an area of 9,400 bigas of land in Bahraich being said to have been destroyed by them. From Chupra (Bengal) also specimens of *Ochropleura flammatra* were forwarded in March 1891 to the Museum by Mr. J. A. Bourdillon, with the information that the insect had appeared in immense numbers. In the same month some obscure cut-worm larvæ were forwarded to the Museum by the Manager of the Dighaputya Wards Estate, Rajshahye, with the information that they had been injuring nearly full-grown potato (*Solanum Melongena*) plants. In this case the insect is likely to have been *Agrotis suffusa*, which is known to attack potato plants in India, but the material is insufficient for precise identification.

Tusser Tachinid.

The Bengal silk-worm fly *Trycolyga bombycis* Becher is well known on account of the damage it does in rearing establishments in Bengal where the mulberry silk-worm (*Bombyx sp.*) is cultivated, and attention has recently been called to an allied insect which attacks the Tusser silk insect (*Antheræa mylitta*) very much in the same way. In the collections of the Indian Museum there is a specimen preserved in alcohol of a full grown Tusser caterpillar from Singhboom, which has been attacked by no less than fifteen grubs of the Tusser Tachinid. These grubs are yellowish white in colour, of the ordinary Tachinid shape, with a pair of easily seen mandibles in front and a pair of black stigmata behind. Four individuals were found inside the caterpillar's body, and the remainder had cut their way out through irregular holes that were to be seen in different parts of the skin. Almost the whole of the tissues of the caterpillar had been devoured, no doubt while it was still alive, and the specimen that remains is little more than an empty skin. Many of its stigmata have a dark coloured patch on the inside, no doubt due to the grubs having attached themselves against the stigmata of their host in order to enable their own posterior stigmata to be in connection with the outer air. This somewhat unusual habit has also been recorded in the case of the *Uji* fly (*Udschimyia sericariæ* Rondani) which attacks mulberry silk-worms in Japan, and is a parasite with which the Tusser Tachinid seems to have some affinity. Specimens of the Tusser Tachinid were submitted to Mons. J. M. F. Bigot, who has kindly examined them

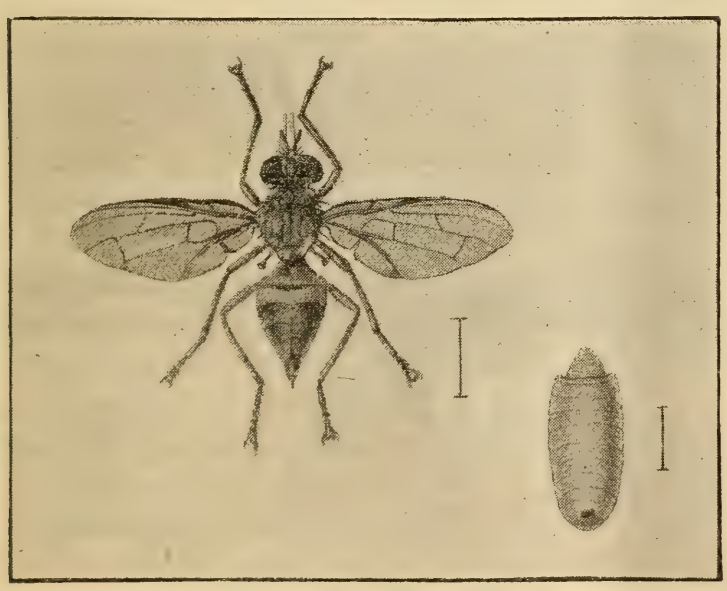
and reports that they belong to the species *Masicera grandis* (= *Tachina grandis* Walker, Ins. Saund. Volume I, page 278, 1856).

An enemy of the rice-sapper.

In October 1891 Mr. J. R. Cripps of Chumparun forwarded specimens of the beetle *Cicindela sexpunctata* Fabr. which was said to devour the *rice-sapper* (*Leptocorisa acuta* Thunb.) and to be very effectual in keeping it in check. The beetles were said to come from the buffalo dung which the cultivators were in the habit of putting into their paddy fields with the express object of rearing the insect in order to keep down the numbers of the destructive *rice-sapper*. It is difficult to see what connection there could be between buffalo dung and Cicindelidæ, but it is worth noticing that a similar idea exists in the Punjab, where the prevalence of the Carabid beetle *Calosoma orientale* Hope, which proved useful in destroying young locusts (*Acridium perigrinum* Oliv.) in the spring of 1891, was attributed in Kohat to the unusual quantity of the fœces of cattle left upon the roads, owing to the large number of transport animals which had recently passed through the district to the Miranzai Expedition.

Mango maggots.

In July 1891 a number of Dipterous larvæ were forwarded to the Museum through the Calcutta Agri.-Horticultural Society, with the information that they had been attacking mangoes (*Mangifera indica*) in Tirhoot. The



larvæ were found to be yellowish maggots, about the size of small grains of boiled rice. They had the pointed head and truncated abdomen so common amongst Dipterous larvæ. When liberated from the pulp of the mango they progressed partly by crawling and partly by gathering the head and posterior together and leaping into the air some four or five inches at a time. A mango in which the grubs were received was placed on a plate of damp earth in the Museum, and the grubs rapidly made their way out and tunnelled into the earth. Here they remained from the 13th

to 22nd of July, when a large number of flies emerged. These flies proved to be identical with a specimen in the Museum collection previously identified by Mons. J. M. F. Bigot as closely allied to the species *Dacus ferrugineus* Fabr., they were therefore provisionally named *Dacus ferrugineus* var. *mangiferæ*. They have since been compared by Mr. O. E. Janson with specimens in the British Museum and identified as belonging to the species *Dacus ferrugineus* Fabr. The insect is no doubt the one reported on page 38 of Volume II of these notes as destructive to mangoes in Mozafferpore. According, however, to the observations of Messrs. Simmons and Blechynden in Calcutta, the insect generally confines itself to over-ripe, injured, and decaying fruit; and it has been suggested that its excessive multiplication in the present case may have been due to previous injury to the mangoes by hail.

The figure shows the imago and pupa, the natural size is indicated by hair lines.

Shorea assamica borers.

In August 1891 a block of *Makai* wood (*Shorea assamica*) was received through the Dehra Dun Forest School, from the Deputy Conservator of Forests, Lakhimpur Division, Assam. It was found to be tunnelled in all directions by Cerambycidæ larvæ. A full grown beetle emerged shortly after the block was received and proved to be closely allied to a specimen in the Museum collection determined by Dr. Lameere as *Neoceramhyx holosericeus* (= *Æolesthes holosericeus Gahan*). It differs, however, from this species in possessing a series of spines on the antennæ. A specimen of the Cucujid *Hectarthrum brevifossum* Newm. also emerged in the rearing cage from the same block, and may perhaps prove to be parasitic on the Cerambycid.

Poplar Ægeriid.

With reference to the Baluchistan Poplar Ægeriid (*Sphecia ommatiæformis* Moore), Mr. J. Cleghorn writes in April 1891, that he is now only able to find half-grown caterpillars, and that these are situated between the bark and the wood. This tends to confirm the supposition that the insect's life cycle is an annual one, and that the eggs are laid in the autumn in the bark; the caterpillars would thus have time to get through the bark before the sap mounts in the spring, when they commence tunnelling into the heart of the wood. The percentage of attacked trees was found to be very much smaller in 1891 than in 1890,—a feature which Mr. Cleghorn attributes to the hardness of the winter of 1890-91.

Pinus excelsa Scolytid.

In May 1891 the Conservator of the Forest School Circle forwarded, from his camp near Chakrata in the North-West Himalayas, a log of *Pinus excelsa*

attacked by a bark boring Scolytid. This insect was said to have attacked some trees that had been girdled and were dying. The specimens were submitted to Mr. W. F. H. Blandford who very kindly examined them and determined them as belonging to a species of *Polygraphus* near to the European form *Polygraphus pubescens* Linn. For an account of *P. pubescens*, which Mr. Blandford thinks likely to prove similar in habits to the *Pinus excelsa* insect, see Eichhoff. Eur. Borkenkäfer, page 122, (1881).

Melon seed moth.

In April 1891 some Melon (*Cucurbitaceæ*) seed attacked by the caterpillar of a minute Microlepidopterous insect, was forwarded to the Museum from Peshin, Baluchistan, by Mr. J. Cleghorn. The eggs were thought to have been laid upon the seed in October. Throughout the winter the grubs fed upon the outer portion of the seeds and in April, when the seed is usually taken out to be sown, the caterpillars deserted it and formed their chrysalids on the sides of the bag in which the seed had been stored. The attempt that was made in the Museum to rear the moth for identification was not successful, but the insect is not thought to be of much importance.

Chir pests.

In July 1891 a number of insects were received through the Director of the Dehra Dun Forest School, from the Officiating Conservator of Forests, Central Circle, North-Western Provinces and Oudh, with information that they had proved destructive to Chir (*Pinus longifolia*) in the Baldhoti plantation.

The specimens were found to comprise four species of Acrididæ (*viz.*, *Chrotogonus sp.*, *Catantops indicus*, *Caloptenus sp.*, and *Œdalus sp.*), all said to nip off the young plants, also numerous obscure Curculionidæ beetles and earwigs (Euplexoptera) said to be found in dying trees, and probably therefore of but little importance. The Acridid responsible for most of the nipping off of the young *chir* trees is probably the *Chrotogonus*, of which numerous specimens were furnished. This insect is a very common one in many parts of India, and has repeatedly been sent to the Indian Museum as destructive to crops, but no satisfactory method seems to have yet been discovered for dealing with it. The bran and arsenic insecticide, which is said to have been successfully used in the United States against some kinds of Acrididæ, might perhaps be worth trying. It is made by mixing together one part of arsenic, one part of sugar, and six parts of bran, with a little water to form a paste. It should be sprinkled over the plantation for the Acrididæ to eat, the greatest care, however, is necessary in using it on account of the poisonous nature of the arsenic.

Trogositid beetle in Indian wheat.

In a sample of wheat (*Triticum sativum*) from Orissa, which was kept under observation in the Indian Museum during the autumn of 1890, were found numerous small brown beetles (Trogositidæ), which seemed to be associated with the wheat weevil in destroying the grain. Specimens were sent to Mons. Fairmaire, who kindly examined them and reported that they belonged to the species *Trogosita mauritanica* Linn. Mons. Fairmaire adds that this insect has long been known on account of the damage done by its larvæ in wheat granaries. The imago is thought to be carnivorous in its habits, and feeds on the small Tinied moths which are to be found in granaries. The insect is a cosmopolitan one, having no doubt been distributed over the world with grain. The figure shows the imago with much enlarged diagrams of antenna and hind leg. The natural size of the insect is indicated by the hair line.

Crocus caterpillar.

The gaudily coloured caterpillar which have been noticed as defoliating garden plants in Calcutta and Dehra, has recently been reared in the Museum and found to belong to the Noctues moth *Polytela gloriosæ* Fabr. When full fed the caterpillars tunnelled into the ground, where they formed for themselves typical Noctues cells of hardened earth. The first pupæ were formed on 19th July, and the moths began to emerge on the 8th August. The caterpillar may be observed at work throughout the rainy season in Calcutta gardens where it does a good deal of damage to ornamental plants, and as the time spent by the chrysalis in the ground is short, it is probable that the insect passes through a number of generations in the year.

Lasiocampid caterpillars in Burma.

Some hairy caterpillars of a Lasiocampid moth, not previously represented in the Indian Museum collection, were received in November 1891 through Mr. De-Niceville from Rangoon, with the information that the insect had been very destructive. A letter, dated 5th December 1891, upon the subject, was subsequently forwarded from Mr. Noble of the Phayre Museum. In this letter the following report from the Northern Division, Shwebo, Burma, was quoted, but the date of the appearance of the insect was not mentioned :—

"The rain still holds off, and the winds are exceedingly high, unprecedentedly so. The people say—from these high winds blowing the people anticipate a heavy monsoon

and the circumstance which is said to indicate the approach of plentiful rain is a plague of a species of hairy caterpillar which literally covers the country, destroying the herbage and swarming on the roads to such an extent that thousands of them must be trodden under foot by passing wayfarers. Contact with the hairs produces irritation and even sores. The caterpillar is said to turn into a species of yellow butterfly or moth about August. Burmese name *Pagaungde* or *Rugaungde*."

The specimens have been forwarded to Mr. F. Moore[1] for favour of determination, and further information is awaited from Burma.

Mysore coffee ringer.

Mr. R. H. Morris of Mysore sent (21st April 1891) a series of moths which he has reared from the Mysore *coffee ringer* caterpillars noticed in Volume II, page 7, of these *Notes*. Five of these moths belonged to the species *Agrotis segetum* Schiff., while the sixth was a *Heliothis armigera* Hübn., which is not thought likely to have been connected with the "ringing" of the young coffee plants. Comparing these specimens with the ones noticed on page 7 of Volume II of these *Notes*, we find that out of eight moths reared from caterpillars thought to be the destructive coffee *ringers* of Mysore, six belong to the species *Agrotis segetum*, one to the species *Heliothis armigera*, and one to a species which has been identified through the kind help of Mr. F. Moore as *Orthosia bicornis* Hampson. It may be concluded that *Agrotis segetum* is the insect chiefly concerned in the injury to the coffee (*Coffea arabica*) plants.

With regard to the practicability of poisoning such caterpillars by strewing the ground with succulent cabbage leaves sprinkled with London purple, as has been recommended by the United States Entomologist (*vide* page 33 of Volume I of these *Notes*), some London purple was sent to Mr. Morris for experiment, but he writes that, though it certainly poisons the caterpillars, the cost and difficulty of laying down the poisoned leaves over so large an area as a coffee estate, are prohibitive.

Bamboo Aphid.

In March 1892 specimens were forwarded by the Director of the Forest School, Dehra, of an Aphid which was found attacking the leaves of *Bambusa arundinacea* in the school compound. The insect covered the leaves with a black sticky gum which was in such quantities that it fell off in drops. The insect is unnamed in the Museum collection, and specimens have therefore been forwarded to Europe for comparative examination.

In July 1890 an obscure Geometrid caterpillar, insufficient for precise

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[1] The insect has since been identified by Mr. Moore as a new species of *Spalyria*, which he is describing as *Spalyria minor*.

identification, was forwarded by Messrs. Mackinnon, Mackenzie & Co., from Nowgong, Assam, where the insect was said to have been damaging the tea (*Camellia theifera*) bushes. Geometrid caterpillars have not previously been reported as doing any appreciable damage to tea, and the present insect therefore is not expected to be of much importance.

Geometrid caterpillar on tea.

Insects said to infest the *Terminalia belerica* tree in the Thana district, Bombay, were forwarded to the Museum in February 1891 by Mr. F. Gleadow of the Forest Department. The insects were found to be of two kinds—(1) a Bostrychid borer, identical with specimens reported on by Dr. Günther of the British Museum as *Sinoxylon sp.*, and (2) a small Cucujid which has been submitted to Mons. Fairmiare, who has kindly examined it, and reports that it belongs to the species *Læmotmetus insignis* Grouville. The Cucujid is not likely to do much damage, but the Bostrychid is very probably destructive.

Terminalia belerica pests.

Amongst the enemies of wild silk-worms in India may be noticed a large yellow Ichneumonid received from Hazaribagh, where it was said to attack the caterpillars of *Cricula trifenestrata*. The same insect has been bred in the Indian Museum for a caterpillar of the Hesperid butterfly *Telegonus thrax*, also from a cocoon of the wild silk insect *Antheræa roylei*. In the latter case it had destroyed the chrysalis and filled the cocoon with its own pupal cells as shown in plate 9, fig. e, of volume II of these *Notes*. The Indian Museum also contains specimens from Sikkim, bred by the late Mr. Otto Möller, both from the butterfly *Telegonus thrax* and also from the wild silk insect *Antheræa frithii*. The specimens in the Museum collection agree in general markings with the description of *Pimpla punctator*, Linn. as given by Vollenhoven in the Stettin Entomologische Zeitung, volume 40, p. 143, 1879. As however Vollenhoven gives Java, Sumatra, Borneo, Celebes, and China as the habitat of the species, and as the only measurement which he gives of the length of body is 11 millimetres, while the average length of both male and female specimens (excluding the ovipositor) in the Indian Museum collection is 17 millimetres, the specimens being very constant in size, it seems best for the present to look upon the Indian form as a variety. This variety may be provisionally named *Pimpla criculæ*, so as to prevent confusion in the event of its proving distinct from *P. punctator* Linn.[1]

Ichneumonid destructive to wild silk insects.

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[1] The specimens have since been submitted to Mr. P. Cameron, who notices (Mem. and Proc. Manchester Lit. and Philos. Soc., 1890-91) that they belong to the special *Pimpla punctator* Linn. a species which he remarks is widely distributed over the oriental region. Mr. Cameron also notices the species *Pimpla zebra* Vollenhoven as bred from *Cricula trifenestrata*.

Determination of miscellaneous pests.

The following miscellaneous pests have been determined for the Museum by Mr. Oliver E. Janson :—

(1) A Dipterous insect said to attack mangoes (*Mangifera indica*) in Lower Bengal. This was compared with specimens in the British Museum and identified as *Dacus ferrugineus* Fabr.

(2) Cantharidæ said to damage crops of yellow cholum (*? Sorghum vulgare*) in Madras. These were compared with specimens named by Dr. Haaq, and identified as belonging to the two species *Epicauta rouxi* Cast. and *Epicauta tenuicolli* Pall.

(3) Tenebrionidæ said to attack young linseed (*Linum usitatissimum*) and wheat (*Triticum sativum*) plants in Katwa, Bengal, determined as *Opatrum depressum* Fabr.[1]

(4) Dermestidæ destructive to stored wheat (*Triticum sativum*) in the Delhi bazaar, identified as *Æthriostoma undulata* Motsch.

(5) Bostrychidæ said to have been found boring into the stem of a guava tree (*Psidium Guava*) in Hazaribagh, identified as *Bostrychus sp.*, *Sinonxylon sp.*, and *Cænophrada anobioides* Waterhouse. The last species was identified after comparison with the type specimens.

(6) Curculionidæ reported as destructive to Hibiscus plants in Durbhunga, identified after comparison with the original type specimen, as *Desmidophorus hebes* Fabr.

(7) Curculionidæ reported as destructive to garden plants in Durbhunga, identified as *Astycus lateralis* Fabr.

(8) White-ants forwarded from Balasore in December 1888, compared with the original type specimen and identified as *Termes taprobanes* Walker.

In the *Memoirs and Proceedings of the Manchester Literary and Philosophical Society*, 1890-91, Mr. P. Cameron describes and figures the following insects which he has been so kind as to examine. It is hoped that the insects will shortly be returned so that the type specimens may be preserved in the collections of the Museum :—

(1) *Platygaster oryzæ* n. sp. (plate 1, figs. 6 and 8) bred by Mr. Wood-Mason from *Cecidomyia oryzæ* W. M., a midge said to have proved destructive to paddy (*Oryza sativa*) in Monghyr in October 1880.

[1] The species *Opatrum micans* is recorded as injurious to crops by Miss Ormerod. (Injurious Insects of South Africa, p. 19).

(2) *Aphelinus theæ* n. sp. (plate I, figs. 5 and 5*a*) bred by Mr. F. W. H. Miles from the tea scale insect *Chionaspis theæ* Maskell.

(3) *Pteromalus oryzæ* n. sp. (plate I, figs. 2 and 2*a*), believed to be parasitic on the rice weevil *Calandra oryzæ* Linn.

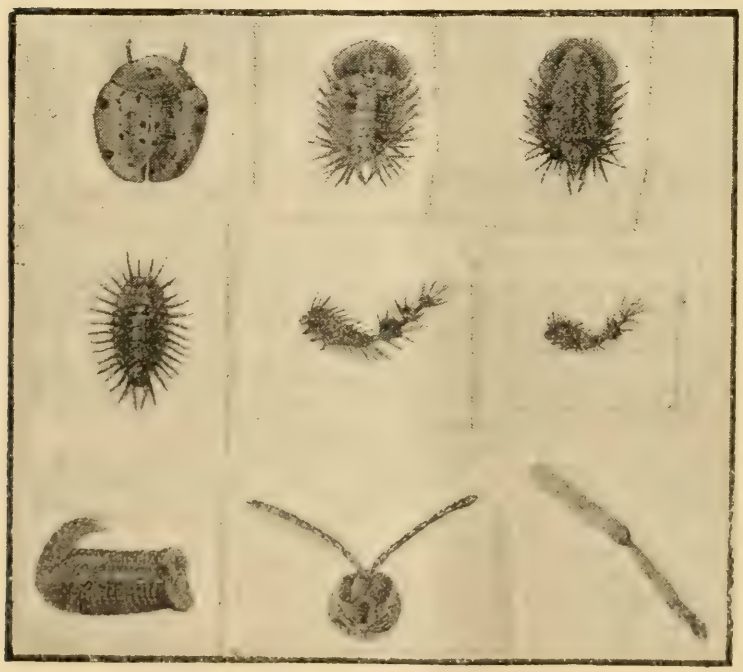
(4) *Cotesia flavipes* n. sp. (plate I, figs. 3 and 3*a*) bred in the Museum from caterpillars of the destructive sorghum borer *Diatræa sp.* received from Poona.

Stromatium barbatum.

Specimens of the Cerambycid beetle *Stomatium barbatum*, Fabr., were forwarded to the Museum in June 1891 by the Director of the Forest School, Dehra, with the information that they had been damaging wood specimens in the School Museum. A block of khair wood (*Acacia Catechu*) that was forwarded with the beetles was found to have the whole of the sap wood riddled with tunnels made by the larvæ. These tunnels were tightly packed with the powdered wood that had been eaten out and probably passed through the digestive organs of the grub. The hard heart wood was untouched.

Aspidomorpha militaris.

The Cassid *Aspidomorpha militaris* Fabr., has been reared in the Museum upon convolvulus (*Convolvulaceæ*) leaves. Young larvæ received on 7th July became adult on 29th of the same month, by 20th September these imagos had laid a large number of egg capsules, which produced young larvæ. In the rains in Calcutta, therefore, this insect takes little over two months to complete the cycle of its existence. The egg capsules are large oblong agglutinated masses, sometimes more than half an inch in length. The larvæ are the little spined creatures shown in the figure. They shed their skins at intervals, the cast skins remaining



attached to the spines at the posterior of the abdomen. In the pupa, see figure, these cast skins are dropped. The insect is not known at present to do any damage to crop in India, but it is one of those common species which are always liable to multiply to such an extent as to prove destructive as defoliators. The figure shows the imago dorsal view, the pupa dorsal and ventral view, three stages of the larva, and egg capsule, all natural size, also front view of the head and one of the legs both much enlarged.

Stored pulse pest.

Attention was called in December 1891 to damage done to Arhar pulse (*Cajanus indicus*), stored in Calcutta, by *Bruchus chinensis* Linn. This insect is the common *gram weevil* of Lower Bengal, and is often very troublesome.

Gall-nut tree defoliator.

In March 1891 specimens of an insect, said to injure *gall-nut* trees (*? Teminalia Chebula*) on the Kambakkan hills, were sent to the Indian Museum, through the Dehra Forest School, by the District Forest Officer, Chingleput, Madras. The specimens proved to be little cone-shaped larval case of a Psychid moth. They were a little larger in size but otherwise indistinguishable from the larval cases of the species *Babula grotei* Moore, a species which often defoliates ornamental shrubs in Calcutta gardens.

Scale insects on tea.

In December 1891 information was received through Messrs. Mitchell, Reid & Co., of the presence in small numbers of the Coccid *Chionaspis theæ* Maskell (=*Aspidiotus theæ* green MS.) on tea (*Camellia Thea*) in the Kangra valley. The curious little fluted scales of the male insect of this species were represented in considerable numbers upon the leaves that were sent to the Museum for examination. No particular harm seems to have been done as yet by this insect, but it is one to be watched carefully as it has now established itself upon tea both in the Himalayas and in Ceylon, and may at any time prove destructive. It is satisfactory to learn that the kerosine and soap emulsion which have been recommended for use against this insect have been used successfully in the Kangra valley.

Apis dorsata.

According to a note furnished by Mr. J. Sinclair, the large jungle bee *Apis dorsata* is more abundant on rocks at from 2,000 to 3,000 feet elevation, under the 19th, 20th, and 21st degrees N. Latitude, in the Ghâts, Deccan, and Konkan, than in any other position in that region. It is, however, found in old buildings (and sometimes in new ones), upon large trees and

in other suitable positions pretty commonly throughout the Regulation Districts of Bombay from sea-level upwards. On the upper Ghâts (as at Mahableshwar), it perforce confines itself to rocks and buildings, for big trees where it can build its nest in safety are scarce.

Red spider.

A note written some years ago by Mr. M. H. Clifford, late of the Forest Department, has recently been found amongst some old papers in Dehra. According to this note native hakims extract a kind of oil from the large velvety red mites (*Tetranychus sp.*), commonly known as *red spiders or Birbhoti* in the North-West Provinces. The oil is sold for medicinal purposes at a high price, and even the insects themselves fetch as much as a rupee per tola. It will be interesting to learn if anything further is known of the medicinal virtues attributed to this mite.

Insect pests in Baroda.

Mr. T. H. Middleton of the Baroda College, writing in August 1891, notices a good deal of damage to sugarcane (*Saccharum officinarum*) on the Baroda College farm by an insect which is known locally as *Narkote*, and which, from the description, appears to be the well known sugarcane borer *Diatræa saccharalis*. He also notices a voracious hairy caterpillar from an inch to an inch-and-a-quarter in length, and red, brown, or nearly black in colour, which appears after the first fall of rain, and is very abundant for about three weeks, after which it disappears as suddenly as it came. It chiefly attacks young plants, and plants growing along the surface of the ground. It is known by the natives as *Katra*, and is no doubt the larvæ of one of the Bombyces moths, many of which are injurious defoliators.

Insect pests in Hooghly.

In August 1890 specimens of paddy (*Oryza sativa*) injured by insects were forwarded to the Museum, through the Director of Land Records and Agriculture, Bengal, from the Collector of Hooghly. With the paddy stalks were found specimens of the two Chrysomelid beetles *Hispa æuescens* Baly and *Aulacophora abdominalis* Fabr. The damage is likely to have been chiefly due to the first of these insects, which is a well known rice pest in Lower Bengal.

Insect pests in South Arcot.

Specimens have been received, through the Central Museum, Madras, of some insects said to have proved injurious to *chambu* (*Pencillaria spicata*) and *cholum* (*Sorghum vulgare*) in the South Arcot District in December 1891. The insects prove to belong to two species, the first of these is *Nezara*

viridula Linn.—a cosmopolitan Pentatomid which has previously been sent to the Museum as occurring on potato (*Solanum tuberosum*) halms in Bangalore. The second is a small Capsid, which is as yet unnamed in the Museum collection. Specimens are being sent to Europe for precise identification.[1]

Tusser in the Punjab.

In a paper published in the Journal of the Agri.-Horticultural Society, Calcutta, Vol. VIII, 1890, Mr. W. Coldstream gives further particulars of his attempts to cultivate Tusser silk worms (*Antheræa mylitta*) in the Punjab. The experiments were chiefly conducted in Hoshiarpur and Lahore, and they extended through several years. The outturn of cocoons seems to have been very unsatisfactory, but as the result of his experiments, Mr. Coldstream concludes that the cultivation of the Tusser silk worm, as a cottage industry, is by no means impossible in the submontane districts of Northern India where the *Zizyphus jujuba* tree flourishes.

Pœcilocera picta.

In July 1890 a specimen of the Acridid *Pœcilocera picta* Fabr. was furnished, through the Director of Land Records and Agriculture, Bombay, from the Assistant Political Agent, Jhalawa, Kathiawar. The insect was known locally as *Khapedi*. It was said to breed in June, July, and August and to damage the young crops. *Khapedi* seems to be the general local name for Acridid grasshoppers of all kinds, and *Pœcilocera picta* Fabr. is likely to be only one of a number of Acrididæ of local origin which proved injurious to young kharif crops in Kathiawar and Sind in the rainy season of 1890.

Epacromia dorsalis in Sind.

In the early part of September 1892 numerous specimens of the Acridid *Epacromia dorsalis* Thunb., were forwarded to the Indian Museum by the Director of Land Records and Agriculture, Bombay, with the information that they had been attacking young kharif crops in the Upper Sind Frontier district. According to a report subsequently furnished by the Deputy Collector of this district, the young jowari (*Sorghum vulgare*) crop over an area of 570 acres was destroyed by this insect in the early part of the kharif season of 1891. The Deputy Commissioner adds—"these insects appear generally on the lands situated in the vicinity of the hills stretching along the northern bank of the Desert Canal, and cause considerable damage to germs of kharif crops while the sowing operations are still in progress."

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[1] Mons. Lethierry has since examined this insect. He determines it as a new species of *Calocoris* which he is describing under the name of *Calocoris angustatus*.

Acrididæ attacking tea.

In February 1892 information was received through Messrs. Jardine, Skinner & Co., of considerable injury to young tea (*Camellia theifera*) bushes in the Western Doars by Acrididæ. Of the insects forwarded to the Agents, some were identical with specimens in the Museum collection determined by Dr. De Saussure as his *Catantops indicus*, while others seemed to be a variety of the same species, characterized by the absence of striped markings on the posterior femora.

Two specimens of the species *Acridium flavicorne* Fabr. were afterwards forwarded as associated with the insect first reported. In the end of February the Manager wrote that he had been to a great extent successful in destroying the insects, and that he had not heard of their appearing on any of the neighbouring gardens. The method adopted was hand-collecting by children and coolies, who were paid two annas per hundred insects. Up to the date of his letter, the Manager estimated that he had destroyed 31,770 insects in this way, with the result that they were getting so much scarcer that, at the time he wrote, the coolies were only bringing in about 25 per cent. of the daily number they had been able to obtain when hand-collecting was first started.

Acrididæ in Vizagapatam and Cuddapah.

Specimens of the Acridid *Acridium æruginosum* Burmeister were forwarded, in the early part of August 1891, through the Madras Museum, from the Collectorate of Vizagapatam and also from that of Cuddapah for identification. In the case of the specimens from Vizagapatam the females were found to have their ovaries crammed with ripe eggs. *Acridium æruginosum*, therefore, is likely to have been the insect referred to by the Collector of Vizagapatam, who wrote on 18th July that a flight of locusts had recently visited the Royaghada taluk in his district and caused slight damage to the standing crops. He noticed that these locusts appeared to have laid eggs which had hatched. The winged insects had disappeared, but the young locusts were still to be found on the hills at the time the report was made.

Acridium æruginosum is one of the six local species of Acrididæ which have been reported as concerned in the Madras locust invasion of 1878. The flight of locusts, therefore, which visited the Vizagapatam District in July 1891 must not be confused with the flights which had previously invaded the whole of the Madras Presidency, and which consisted of insects belonging to the very different species *Acridium peregrinum* Oliv. which had made its way across India from the North-West Frontier.

Unfortunately no record is forthcoming of the part played by the six local species of Acrididæ which were reported in connection with the

Madras locust invasion of 1878, but it may be worth noticing that in the set of specimens that reached the Indian Museum, as responsible for the damage that was done in 1878, *Acridium æruginosum* was represented by more specimens than any of the other species, so it may perhaps have been the insect referred to by the writers of most of the reports, who seem to have noticed but one kind of insect.

Acrididæ in Gangam.

In November 1891 a number of Acrididæ were forwarded as the locusts which had lately appeared in the Chicacole Taluk of the Ganjam Collectorate. The specimens proved to belong to no less than six very distinct species of grasshoppers. The following is a list of them:

(1) *Hieroglyphus furcifer* Sauss. (seven specimens of which five were immature), (2) *Oxya velox* Burm. (two immature specimens), (3) *Acrida turrita* Linn. (two mature specimens), (4) *Euprepocnemis bramina* Sauss. (two mature specimens), (5) *Atractomorpha crenulata* Fabr. (one mature specimen), (6) *Epacromia, dorsalis* Thunb. (one mature specimen). These species are all likely to attack plants and may perhaps do some damage to crops over restricted areas, but none of them are known to occasion any such widespread injury as that which is often done by migratory locusts.

Acrididæ in Meywar.

In April 1891 a number of Acrididæ collected in Meywar were forwarded to the Museum, through the Government of India, from the Agent to the Governor-General in Rajputana. They were thought to have been associated with the locust invasion of Meywar, but it is more probable that they were merely representatives of local species of Acrididæ that were to be found after the flights of the true locust (*Acridium peregrinum* Oliv.) had passed away. The insects have been compared with the specimens in the Museum collection named by Dr. De Saussure, and have been identified as follows: ten specimens of *Catantops indicus* Sauss., four specimens of *Chrotogonus trachypterus* Blanch., one specimen *Epacromia dorsalis* Thunb., and three specimens doubtfully identified as *Trilopidia annulata* Thunb.

Acrididæ in Godavari.

A number of specimens of the large green Acridid *Pœcilocera picta* Fabr. were forwarded to the Indian Museum in October 1891 from the Godavari District. Details of the damage done by this insect have not yet been procured.

Acrididæ in Howrah.

In September 1890 some Acrididæ, known locally as *Kat foring*, were forwarded, through the Director of Land Records and Agriculture, Bengal, from the Deputy Collector of Howrah, with the information that they had been damaging the immature ears of paddy (*Oryza sativa*). The insects were found to comprise a single individual of the species *Catantops axillaris* Sauss., and seven specimens of a species of *Euprepocnemis* unnamed in the Museum collection.

Grasshoppers associated with locusts in Kohat.

The following Locustidæ and Acrididæ were forwarded in June 1891 by Captain G. C. Parsons, Deputy Commissioner of Kohat. They were found associated with the destructive locust *Acridium peregrinum* Oliv. in Kohat, but this association is thought likely to have been accidental only. It may be useful, however, to record the species that were prevalent at the time that the locusts appeared. The species sent to the Museum were as follows:—(1) A species of *Mecapoda* (Locustidæ) male and female. (2) *Acridium melanocorne* Serv. (Acrididæ), khaki coloured insect with no very definite wing markings. (3) *Acridium æruginosum* Burm., with stripes on the back and sides of the prothorax. (4) Small grasshoppers which have been determined as *Epacromia dorsalis* Thunb., *Euprepocnemis bramina*? Sauss., and *Sphingonotus sp.*

The Rosy pastor *versus* locusts.

A very interesting series of reports on the subject of the destruction caused amongst locusts of the species *Acridium peregrinum* Oliv. in the Punjab, by the Rosy pastor (*Pastor roseus* Linn.), which is known as the *Sauch*, *Tiiia*, or *Jowari* bird, have been furnished by the Secretary to the Government of India in the Revenue and Agricultural Department. Reports also that have been furnished through the Director of Land Records and Agriculture in Bombay show that the same bird has long been noticed as very effectual in destroying locusts in Sind. The species to which the bird belongs has been determined by Mr. W. L. Sclater from specimens received from Bannu, Kohat, and Gujranwala, forwarded to the Museum by the Director of Land Records and Agriculture, Punjab, through whom also most of the reports have been procured. In view of the great effect which the bird undoubtedly has in keeping the locusts in check, it has been suggested in several quarters that it might be a good thing to take measures to have it protected by legislation. It seems very doubtful, however, to what extent any such measures would be useful in the end, in view of the great injury which the bird is said to do to grain crops in India.

The following account of *Pastor roseus*, Linn (the rose-coloured Star-

ling or Rosy pastor) is taken from Jerdon's *Birds of India*, Volume II, page 333 :—

"It usually makes its appearance in the Deccan and Carnatic about November, associating in vast flocks, and committing great devastations on the grain fields, more specially on those of the cholum or jowaree (*Andropogon sorghus*), whence its familiar name in the south. Mr. Elliot, in his manuscript notes quoted in my catalogue, says: 'Is very voracious and injurious to the crops of white jowaree,' in the fields of which the farmer is obliged to station numerous watchers, who, with slings and a long rope or thong, which they crack dexterously, making a loud report, endeavour to drive the depredators away. The moment the sun appears above the horizon they are on the wing, and at the same instant shouts, cries, and the cracking of the long whips resound from every side. The Tilliaers, however, are so active that if they are able to alight on the stalks for an instant, they can pick out several grains. About 9 or 10 o'clock A.M. the exertions of the watchmen cease, and the Tilliaers do not renew their plundering till evening. After sunset they are seen in flocks of many thousands retiring to the trees and jungles for the night. They prefer the half-ripe jowaree, whilst the farinaceous matter is still soft and milky. When they can no longer get grain, they feed on various grass and other seeds, flower-buds, fruit, and also on insects, seeking them on the ground, but they are rarely seen with cattle in India. The Telugu name is derived from the name of a plant whose fruit they are particularly fond of. Mr. Blyth remarks that 'they visit the neighbourhood of Calcutta only at the end of the cool season, when flocks of them are not unfrequently observed upon the arboreal cotton tree then in bloom.'

"Burgess states that he has seen them busily feeding on the flowers of the leafless caper, a shrub very common in the Deccan, on the banks of the larger rivers. Dr. Adams says that 'it is very abundant in the Punjab, committing great havoc on the grain there.' In the north-west of India, and in Afghanistan, they devour large quantities of mulberries in spring, hence called the '*Mulberry-bird*' in the north-west, disappearing afterwards. They at times, however, feed much on insects, and are called the 'locust-eater' in Persia, according to Chesney. They do not breed in this country, quitting the south of India in March, but lingering in the north a month or so longer. It is ascertained that they breed in vast numbers in Syria and other parts of Western Asia, in rocky cliffs. Burgess states his belief that they breed in India somewhere, and was informed by a native that they do breed in the Ghâts. This however is, doubtless, totally without foundation. Mr. Layard states that one year he saw large flocks of these birds in July, that they remained only a week, and then disappeared. They were entirely unknown to the Natives. Burgess also states that in 1850, towards the end of August, he saw a large flock of the rose-coloured starlings feeding on insects in an open field. These instances of their appearing so early are very unusual, and more especially their occurrence in Ceylon in July, by which time the young could only have been just fairly fledged."

Mr. M. F. O'Dwyer, Settlement Collector of Gujranwala, quotes an interesting Hindoo legend, to the effect that in response to the prayers of the people, the locusts have been imprisoned in a deep valley, surrounded by impenetrable mountains in the west of the Himalayas. The exits from this valley are guarded by *Tilliars* (rosy pastors), commissioned by heaven for the purpose. Now and then, when the sentinels fail in their duty of watch and ward, the locusts escape and are hotly pursued by the

Tilliars, who, unable to drive them back to their prison in the hills, slay them wholesale.

The origin of this legend is supposed to be the fact that the locusts and *Tilliars* generally arrive in Gujranwala from the direction of the hills at about the same time in the spring. It has been noticed also that when the locusts enter a grain field the *Tilliars* do not pursue them into it, but station themselves all round its borders and kill the locusts as they issue forth.

The following are abstracts of the information that has been received upon the subject of this bird :—

The locusts in parts of Sind in 1889-90 were reported to have been exterminated by *jowari* birds, which did not attempt to eat the locusts, but snipped them in two and left them. In Khandesh also, in 1883, the jowari bird or rose pastor was mentioned by Mr. Ommanney as a great enemy of the locusts.[1] (Annual Report, Director of Land Records and Agriculture, Bombay, 1889-90).

In the *Civil and Military Gazette* of 24th July 1891 it is reported that a bird known by the Afghans as *Sanch* has appeared in vast numbers in the provinces of Jellalabad and Lataband, and done much good in destroying locusts.

Major H. P. Leigh, Deputy Commissioner, Kohat, writes (27th August 1891), that all the natives he has questioned agree in describing the *Sanch* bird, said to have appeared in such large numbers in Afghanistan, as a *Tiliar* (starling or rosy pastor). This bird appears in Kohat in large numbers, mixed up with large flocks of Kabul sparrows, when the mulberries are ripe, and migrates down country, re-appearing in the autumn on its way north. The flocks chatter tremendously and dash from tree to tree, but have not been noticed on the ground. The bird is known in Kohat as *Kangira,* and it preys on the locust, though curiously enough it has been almost a stranger in Kohat during the past year, perhaps because it found such abundant food among the locust swarms in Afghanistan and adjacent countries. It is said that the *Kangira* if in small numbers, will not face a dense flight of locusts.

In a letter, dated 29th August 1891, Major H. P. Leigh, Deputy Commissioner, Kohat, recorded the alleged destruction of a flight of locusts by the rosy pastor. Specimens of the bird were at the same time forwarded to the Indian Museum and identified by Mr. W. L. Sclater. The Tehsildar, who was sent from Kohat to arrange for the destruction of some locusts which has appeared in the neighbourhood, reported that the swarm had been destroyed by the starling. He watched them for some time, and noticed that, after killing a dozen or so of insects, the bird would fly off to water, cleanse its bill, and begin again, appearing rather to kill the locusts for amusement than for food, as it left them in the most mutilated condition.

The Deputy Commissioner, Dera Ghazi Khan, wrote (26th August 1891) that the common *Tilliar* or starling (rosy pastor) eats locusts greedily. On one occasion in July, when flights of locusts invaded the station of Dera Ghazi Khan, the *Tilliars* were said to have flown out in a swarm to meet them and attacked them fiercely. The locusts tried to avoid them but did not succeed in doing so, and were beaten off. The damage done in the station was consequently very slight. The *Tilliars* are most numerous in Dera Ghazi Khan from about the middle of July to the end of August.

[1] The locusts referred to by Mr. Ommanney probably belonged to the species *Acridium succinctum* Linn., which invaded the whole of the Bombay, Deccan and Konkan in the years 1882-83.

Specimens of the Rosy pastor (*Pastor roseus*) were forwarded (8th September 1891) by Dr. F. Chand, Civil Surgeon, Gujranwala, as very effectual in destroying locusts.

The Deputy Commissioner, Dera Ismail Khan, wrote (1st September 1891) that *Sanch* is believed to be the Yusafzai-Pashtu for a starling known as *Tilliar* in Hindi and *Sirokka* in Pashtu. He noted that the bird eats, or rather destroys, locusts in a most voracious manner.

On 7th October 1891 specimens of the *Sanch* bird, said to have destroyed a large number of locusts in the Bannu district, were forwarded to the Indian Museum by the Director of Land Records and Agriculture, Punjab. They were identified by Mr. W. L. Sclater as belonging to the species *Pastor roseus* Linn. (Rosy pastor).

The Acting Deputy Commissioner of Thar and Parkar, Sind, reports (21st December 1891) that the *jowari* birds have very materially assisted in clearing the district of locusts.

The Deputy Commissioner, Lahore, notices that the Naib Muhafiz Daftar of Peshawar, informs him that *Sanch* is the Pathan name for the bird known in Lahore as *Tilliar* (Rosy pastor).

Tachinid locust parasite.

A tachinid parasite has been discovered which attacks the winged form of the locust *Acridium peregrinum* Oliv. In June 1891 it was reported that the locusts in Sind were dying in large numbers from the attack of this parasite, and there is evidence also to show that it was to be found amongst locusts in other places. The attempts that have been made in the Indian Museum to rear the parasite have not as yet been very successful, and the paucity of the specimens that have been sent to the Museum tends to show that the parasite is scarcer than has been supposed. In any case, however, the occurrence of a parasite which must necessarily cause the death of every locust it attacks, is of interest, as the species may at any time increase so as to become a most effectual check upon the multiplication of the locusts, and in this case it would be a very valuable ally as it attacks the winged locusts, which are just the ones that are most difficult to deal with by artificial methods. The habits of the parasite have only been partially traced as yet, but what has been observed corresponds so closely with the habits that obtain amongst other members of the same group of insects that we may safely infer the remainder.

The parasite is a two-winged fly, not unlike a very large house fly. It is related to the *Trycolyga bombycis* Becher, which attacks silk worms in Bengal. Like other Tachinids it no doubt deposits its eggs upon the locust's body, and the grubs that have been found attached to the muscles in the thoracic cavity of the locust are no doubt the ones that have hatched out from these eggs and tunnelled their way through the tissues. The grubs that have been found are white legless larvæ about the size of large grains of boiled rice. They have their anterior end pointed and armed with a pair of sharp mandibles. When full-grown they no doubt cut their way out of the locust's body and make their way into the ground, where they transform into little brown bean-shaped pupæ, and in this state they lie until the bean-shaped pupal case splits and the fly emerges ready to seek a mate and to lay eggs of its own.

The following notes show how the question now stands—

On dissecting a specimen of the locust *Acridium peregrinum* Oliv. taken by Dr. L. A. Waddell in the Red Sea on 29th August 1890, grubs of a Tachinid parasite were found embedded in the tissues of the thorax.

One of the specimens of *Acridium peregrinum* taken from a flight which appeared on 27th May 1891 in Gohilwad Prant, Kathiawar (forwarded by the Assistant Political Agent, Gohilwad Prant), was found to have two similar grubs embedded in its thorax.

On the 26th June 1891 the Deputy Commissioner of the Upper Sind Frontier District noticed that the locusts were dying in large numbers from the effect of a grub. Numerous specimens of *Acridium peregrinum* were forwarded in alcohol, and from these two similar Tachinid grubs were obtained. One of these grubs was found loose in the alcohol in which the locusts were preserved, and the second was dissected out of the thoracic cavity of one of the locusts, where it was found attached to the muscles. Careful dissection of all the other specimens that were forwarded failed to reveal any more grubs.

On 27th August 1891 Mr. C. F. Elliot of the Forest Department in Baluchistan forwarded specimens of *Acridium peregrinum* infested by similar grubs which he noticed were very prevalent amongst the locusts then to be found in his neighbourhood.

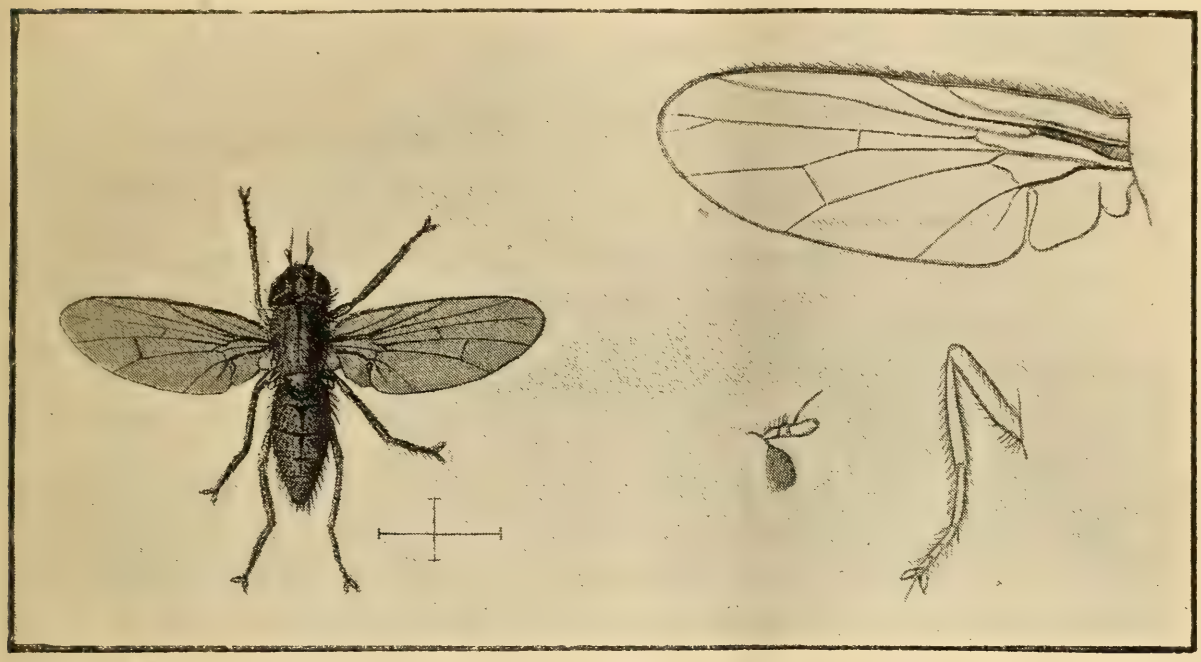
On 29th August 1891 Major H. P. Leigh, Deputy Commissioner of Kohat, forwarded numerous specimens of *Acridium peregrinum* said to be infested by the parasite. From these a single specimen of the fly was obtained, but so much damaged as to be unsuited for precise determination.

On 7th October 1891 further specimens of the same locust, said to be attacked by the parasite, were forwarded by C. E. S. Steel, Esq., Deputy Commissioner, Upper Sind Frontier, Sind, but specimens of the mature insect were not obtained.

Locust egg parasite.

In the early part of April 1891 a vast number of small Dipterous insects, much like diminutive house flies, were reared in the Museum from a set of *Acridium peregrinum* Oliv. eggs received from Peshawar. The flies emerged in great number from the egg masses, and as each fly was probably responsible for the destruction of at least one locust egg, the effect of the parasite in reducing the numbers of the locusts must be very appreciable. Specimens of the fly were sent to Mons. J. M. F. Bigot, who identified them as belonging to a new species of *Anthomyia*, which he proposes to name *Anthomyia peshawarensis*. It may be noticed that an allied species (*Anthomyia angustifrons*) has been found to attack the eggs of the Rocky mountain locust (*Caloptenus spretus*) in America; Dr. Riley, the United States Entomologist, indeed estimates that as much as 10 per cent. of the eggs laid by the Rocky mountain locust are destroyed by it.

The precise life history of the Indian species is not yet known, but it is probably similar to that of its American relation, which, according to Dr.



Riley, deposits its own minute eggs in the ground close to where the locust has previously laid its eggs. Minute maggots rapidly hatch out from the fly's eggs, and bore their way into the egg mass of the locust where they feed upon the contents of the locusts' eggs, and finally transform into little brown pupæ, from which the flies emerge ready to lay more eggs, and thus repeat the cycle of their existence. The figure shows the image of *Anthomyia peshawarensis* Bigot, with much enlarged diagrams of wing, antenna and leg. The natural size of the image is indicated by the hair line.

An enemy of the young locust.

In May 1891 Mr. W. R. H. Merk, Deputy Commissioner, Peshawar, forwarded specimens of Carabid beetle which has been identified as *Calosoma orientale* of Hope. This insect was said to have been observed in vast number in the Peshawar district feeding voraciously upon the young unfledged locusts. The locust referred to is *Acridium peregrinum* Oliv. which has been doing so much damage in Northern India during the last few years. In a report, dated 19th June 1891, forwarded to the Museum by the Commissioner of Peshawar, Captain C. G. Parsons, writes:—

"A black beetle, probably of the kind Mr. Merk sent a specimen of to Calcutta

attacked them with avidity. These beetles seem to be bred out of the fæces of the cattle, from which nest they appear in great numbers after the dropping is a day or two old. The large numbers of transport animals which have recently passed through the district to the Miranzai Expedition have caused the origin of large quantities of these beetles, and they were the locusts' most determined foe."

The figure shows the beetle natural size.

Fungoid locust disease.

In the Comptes Rendus des Séances de la Société de Biologie, Paris, 9th January 1892, Mons. A. Giard gives some account of a fungoid parasite *Lachnidium acridiorum*, which has been found attacking the locust *Acridium* (*Schistocerca*) *peregrinum* Oliv. in Algeria. Mons. Giard writes that this fungus does so little harm to the locusts that it is quite useless to expect any practical result from attempts to spread the disease by artificial means. This conclusion is of interest in view of the suggestions that have been made on the subject of disseminating disease by artificial methods amongst the hordes of the same locust in India.

Troad locust parasites for India.

A suggestion has been made that it might be worth while to attempt the introduction into India of a beetle said to have been discovered by Sir John Lubbock in the Troad, when it was supposed to have been very effectual in keeping down locusts by destroying their eggs.

The insect referred to is no doubt the parasite exhibited by Sir John Lubbock at a meeting of the Entomological Society of London held on 3rd November 1880. This parasite was at first supposed to be the larva of a Cantharid beetle, but afterwards proved (see Proc. Ent. Soc. London, 1881, page xv) to be the larva of a two-winged fly, which seems to have very similar habits to those of the *Anthomyia peshwarensis* Bigot, noticed on page. 34. *Anthomyia peshwarensis* already exists in vast numbers in India, so the place proposed to be filled by the introduction of the Troad species is already at least partly occupied; besides this, however, if the Troad species were able to attack the Indian locust (*Acridium peregrinum*), it would, in all likelihood, have already found its way to India, for there is no geographical obstacle of sufficient magnitude to prevent the spreading of such an insect as the Troad locust fly from the Troad to the Punjab. The locust, indeed, for whose destruction it has been proposed to introduce the parasite, already ranges over most of the intervening countries, and thus offers every facility for the purpose.

Locusts in Kohat.

During the past year a very large number of reports, many of them illustrated by specimens, have been forwarded to the Indian Museum from all parts of India, in connection with the locusts which have been so widely prevalent. With a few unimportant exceptions, these locusts have all belonged to the species *Acridium peregrinum* Oliv., which is the chief migratory locust of the whole of Northern Africa and South-Eastern Asia. In the early part of 1891 a detailed report was issued, in which the information collected on the subject of this insect was brought down to the 1st December 1890. The present number of the *Notes* contains what has since been ascertained on the subject of its prevalence in Northern Africa, Persia, and Turkish Arabia, also on the subject of the parasites, disease, and other natural enemies that attack it. The reports relating to its presence in India are so numerous that they will take some time to arrange. In the meanwhile we take the liberty to quote the following from Captain C. G. Parson's interesting account of the invasion of the Kohat district, as it is very typical of what occurred elsewhere. This report is dated 19th June 1891. It was forwarded to the Museum by the Commissioner and Superintendent of the Peshawar Division :—

"There has been immense opportunity for observing locusts in the Kohat district for about the middle of April the plains of the Kohat Tahsil became alive with young ones of the Peregrinum species which marched down from egg-beds which principally lay beyond the border in the lower part of the hills. Great efforts were made to drive these larvæ into trenches, and enormous numbers were destroyed by mere burial in this way, but the insects were too numerous for a thinly populated district to cope with, and they began to appear from all sides. As they got bigger and developed into the stage (bright yellow green) antecedent to fledging, vast armies marched directly upon the well wooded station of Kohat. They invaded every quarter of it. They crossed the roads resolutely, swam the water-courses, climbed the walls, filled the compounds, and scaled the trees, palings, walls of houses, and telegraph poles. There was no nook or corner that was not alive with these hoppers, and wherever vegetation was thick it was seething with them. In a very few days the trees began to thin, and in ten days there were no leaves left anywhere. The station had all the appearance of winter. The gardens were stripped clean, rose bushes, vines, flowers, and every kind of plant being devoured wholesale. Trees with soft bark, and supple bushes, were so damaged that their stems and boughs were skinned. The only tree which the hoppers disliked for food was the "Bakain" or Persian lilac, and these trees have alone remained green, and for some reason the only flower they eschewed was the larkspur. Whether all the trees and bushes will recover or not is a matter of conjecture, but the Shisham and Mulberry trees and others are beginning again to shoot. I saw several Farash (Tamarisk) trees with their trunks red and raw from base to top where they had been stripped of bark. By the way the hoppers swarmed up and remained packed on the telegraph poles; they appeared to attempt to eat even their dry wood. The station exhaled the most offensive odours, for dead or alive the masses of insects stunk. Many of them entered the houses and ate holes in curtains and hangings. It was impossible to keep the rooms free of them. By congregating in one place in this way they they laid themselves

open to immense destruction. As much as 600 maunds of them were collected and buried in one day, and every day the destruction amounted to hundreds of maunds, nearly all the undetained citizens laboured, for one rupee was given for each maund weighed. The troops also, and the boys of the large High School, were engaged in destroying them. Their collection was very simple, as they could be shaken off the trees by thousands into sheets held below. Four men could collect a maund in very little time. There were three weighing stations established, and the District Funds were freely drawn upon. Some 40 paid labourers were entertained for special destruction in difficult places, but the paid labourer, unless watched the whole day long, contents himself with simply driving the insects about instead of killing them with his flail. On the energy of Mr. Casson, the Assistant Commissioner, seconded by Tahsildar Abdul Quyum, the success of the operations depended. Both these officers worked with a will. Mr. Casson spent several days in trying to save the municipal garden by himself setting an example in manual labour. Owing to his energy and the tahsildars' the destruction was very wholesale. After ten days the majority of the hoppers moulted their skins, and after waiting to get strength of wing, by degrees the whole of them left the station, where in any case there was no food left for them.

"As to the time locusts lay their eggs there is great room for conjecture. At the present moment (or at any rate to within the last few days) in the western portion of the district the *Acridium peregrinum* was obtainable in every phase of development from the eggs to the fully-fledged insect. The process of egg-hatching has therefore continued from the beginning of April to the beginning of June in a tract of country where the difference of elevation only causes a slight change of climate. It may be that the presence of hills accounts for this discrepancy, eggs in hills either taking longer to hatch or being laid later. A Financial Commissioner's circular of 1884 says that July is the ovipositing month of the Punjab locust, but I don't think this can be the case. It is more likely, as Dr. Cotes states, that August, September, and October are the months for the second layings. I do not think the recently fledged insects now flying about will lay for some time. It should be curious to see when the next swarms of larvæ will appear in this district (for the ones now appearing must be late ones of the April or spring brood). If the larvæ appear again during this autumn, it will be clear that there are without doubt two laying seasons in this quarter.

"The enemies of locusts were birds, beetles, and dogs, and the locusts also preyed upon one another. Birds did them very little damage, only attacking them occasionally. Pariah dogs devoured hoppers with relish. A black beetle, probably of the kind Mr. Merk sent a specimen of to Calcutta, attacked them with avidity. These beetles seem to be bred out of the fæces of the cattle, from which nest they appear in great numbers after the dropping is a day or two old. The large numbers of transport animals which have recently passed through the district to the Miranzai Expedition have caused the origin of large quantities of these beetles, and they were the locusts' most determined foe. When the hopper has just moulted his skin he is for some hours a most helpless creature, and in this state is often made a prey of by active hoppers still unfledged. Being no entomologist, I offer the remarks about the specimens I send with diffidence, but any contribution of information is of value in connection with an insect of which the best informed know very little."

Locusts in Northern Africa.

In the spring and early summer of 1891 the whole of Northern Africa was invaded by locusts of the species *Acridum peregrinum* Oliv. This locust (unlike the insect which proved injurious in Algeria in the years 1887-89) is the

one which has been destructive during the past few years in India, so the history of the invasion and the measures taken to combat it in Africa are of particular interest. Besides being destructive in India, *Acridium peregrinum* has been very prevalent, during the past few years, in Baluchistan, Persia, and along the Red Sea coasts, and the invasion of North Africa shows that the unusual multiplication of the species has not been confined to those of its breeding grounds which lie in South-Eastern Asia.

Acridium peregrinum has long been known to breed in the Sahara desert, and every few years it invades the cultivated land to the north. Algeria in particular is so subject to invasion from this species that a regular system of combating it has had to be inaugurated by the French Government. In the present year Tunis and Egypt seem to have been the chief sufferers. Algeria and Morocco, however, have also been invaded, while Tripoli has escaped.

Some excellent reports have been most courteously furnished, through the Government of India, by the British Consuls in Tunis, Algeria, Tripoli, and Egypt. In the cases of Tunis, and Algeria, the insect is specifically identified in the reports as belonging to the species *Acridium peregrinum*: in the case of Egypt it is referred to as *Acridium migratorium*, but as the specimens that have been picked up and sent to the Indian Museum by passing ships in the Red Sea, have invariably belonged to the species *Acridium peregrinum*, which has also been received from Persia and Baluchistan, it will probably be found that the locust which has invaded Egypt is the one so universally prevalent both to the east and also to the west of that country.

The history of the invasion of Northern Africa in 1891 has been very similar to that of previous invasions of the same region by this locust. The chief flights arrived in the spring from the direction of the Sahara desert, and laid eggs which hatched in the early summer. The young locusts, which emerged from these eggs, acquired wings by the middle of the summer, and by the latter part of the summer seem to have nearly completely disappeared. A good deal of damage was done to the crops in Egypt, Tunis, and Algeria, and most energetic measures seem to have been organized by the respective Governments for combating the pest, the result being on all hands admitted to have been very successful. The methods adopted seem to have been very similar to those used in India. They consisted chiefly in destroying the young locusts by driving them into pits or lines of fire, in frightening the winged flights off the crops, and in collecting the eggs. Of these measures the destruction of the young wingless locusts appears to have been the most generally successful. In Tunis a new agent that seems to have been very useful, both in destroying the young locusts and also in lessening the terrible smell which arises from their dead bodies was

creosote oil. This substance, which is known as "Huile lourde," is described as a product obtained by distilling coal tar: 20,000 kilos. of it were obtained from Oran, where the invention originated, for employment in places where fuel was scarce, but the destructive effects of the liquid, combined with its antiseptic properties, caused it to be universally preferred in Tunis to the former system of burning or crushing the locusts. The liquid costs from 11 to 13 francs per 100 kilos. It is mixed with one-and-a-half times its bulk of water, and is used both for sprinkling over small clusters of locusts in the morning and evening when they are banded together, and also for pouring over the masses of locusts that are collected in traps.

The chief reports that have been furnished on the subject of locusts in Northern Africa are as follows:—

(i) A report by Mr. Drummond Hay, on the methods adopted in Tunis for destroying locusts, originally published in the Miscellaneous Series, 1891, of Her Majesty's Foreign Office in London. This report has been reprinted in Volume II, No. 5 of these *Notes*.

(ii) A report on the incursion of locusts in Egypt in 1891, by Mr. Williamson Wallace of the Tewfikieh College of Agriculture at Ghizeh. In Egypt the flights appeared in the middle of April 1891 along the western border of Egypt, extending from Minieh in the south to the Mediterranean on the north. They appeared to come from the west, that is, from the direction of the Sahara desert, which has long been known as the home of *Acridium peregrinum*. They coupled as soon as they arrived, and a few days afterwards they began laying their eggs in the ground. The eggs hatched three weeks after they were laid, and by the middle of May the ground was covered with young wingless locusts. These young locusts became full grown and acquired wings in the latter part of June.

The following extract, taken from Mr. Williamson Wallace's report, shows the measures that were taken in Egypt to cope with the pest: —

"When the locusts appeared in Egypt no very decided effort was made to destroy them. Occupied at this period in reproducing their species, the locusts had done comparatively little damage to the crops. When, however, it was realized that they had actually bred in the country, and that Egypt was face to face with what might soon develope into a national calamity, a most energetic effort was made to get rid of the plague. Orders were issued from the Ministry of the interior to the Moodeers, pointing out the gravity of the situation and instructing them to use every means in their power for the destruction of the locusts. All available Inspectors were despatched to the provinces to assist the Moodeers, while officials were drawn from other departments and charged with this special work. By this time, namely, the 15th of May, the locust had spread to every province of Lower Egypt, except Dakahlieh, Menoufieh, and Gharbieh being the most affected. It was found that the eggs had been principally deposited on the sand islands along the course of the western branch of the Nile, and in the cotton fields. In the fields occupied by the winter crops, principally wheat,

barley, beans, and clover, scarcely any eggs were to be found; the ground at the time being too hard and dry to be pierced by the ovipositors of the locusts. This restriction of the infected area was of the greatest possible advantage. The cotton fields were comparatively empty; the young cotton plants gave little cover to the locusts, and caused little or no obstruction to the operations. Besides this, the proprietor of a cotton field at once reported the presence of locusts, since immediate action could alone save his crop.

"The most simple methods of destruction were found to be the most effectual, such as making long dry trenches 30 to 40 centimetres deep and 25 to 30 wide near to the young broods. Into these trenches the locusts were driven by bands of men and children, often numbering several hundreds, each armed with a palm branch. The men whose duty it was to dig the trenches then lined themselves along the further side of the trench, upon which the earth was thrown to prevent any locusts from escaping. When the locusts were driven into the ditch, the loose earth was at once pulled in by the band of people who had driven them, and trampled down firmly, so that none escaped. These methods proved very successful for the first three weeks, while the locusts were comparatively small, and before they had power to jump out of the ditches. At this stage, therefore, the ditch system became less useful, the locusts being now too wary to be driven easily into the trenches; and the consequent necessitated deepening of the trenches materially increased the cost of operations. It was found that when locusts were disturbed on open ground, such as a cotton field, they would go easily into any cover that was within reach, and remain there. Advantage was taken of this, and whatever available dry material there was in the neighbourhood was taken and spread in patches of several metres in diameter, or in long wide strips. The locusts were then driven into this ambush and surrounded by the people, who simultaneously fired the patch all round, resulting in the complete destruction of the locusts. The dry stalks of maize were plentiful in the country, and made excellent fuel for this purpose. These were the two effectual means by which the locusts were destroyed in Egypt within the space of six weeks. Few of the young ones ever got their permanent wings, and these few were speedily picked up by birds, the common crow positively feasting on them.

"Other means were tried, such as flooding the fields where eggs had been found, but this only retarded the hatching for a few days and destroyed the crops. The locust has considerable swimming powers, and will cross a wide canal if pushed to it. The fellah was very disposed to beat the locusts with his palm branch, instead of driving them forward to the ditch, which often resulted in the greater part of the swarm turning and escaping behind the line of beaters. The screen and trap system of Cyprus was tried with considerable care on the Tewfikien canal, the traps in this trial being lined with bricks. I rode over the ground a week later and found few locusts in those pits, many of which were empty; while quantities of locusts had been destroyed by the methods I have described. Short screens erected immediately in front of locusts are of no practical use, as the locusts are difficult to drive on to them, and the erecting of the screens has a tendency to frighten the locusts and to cause them to change their line of march. This system is only useful where locusts are known to exist on waste lands, and several miles of screens are erected along the edge of the cultivated lands, and thus arrest the natural march of the locusts. If they are to be attacked while they are yet small, and on their own breeding ground, as they must be, in Egypt, this system is too cumbrous for practical working purposes; and the money that would provide the screens is better spent in paying the people for destroying the locusts, and with methods involving no initial outlay whatever.

"Another trap and screen system, invented by Mr. Van Lennup, was tried on the

Nubarieh canal. Thin iron sheets took the place of canvas, and if it were not for the greater initial cost and heavier weight, this system is much superior to the Cyprus plan.

"Locusts may also be gathered by the hand for two hours in the early morning and for an hour after sunset. This semi-dormant condition might in future be taken greater advantage of, by gathering many of them before they deposit their eggs. Government did offer two piastres per oke for locusts, but the people did not seem to realise that they would be paid until most of the eggs were deposited. Two piastres an oke is a sufficient price to pay; and in future it would be well for the Moodeers to order out the people at once, whether they wish to come or not, and pay them for the quantity of locusts gathered at the end of the day. A few days delay may be fatal to the success of this method. The collecting of eggs was a failure. Two piastres per oke was likewise offered for eggs, but the impossibility of gathering them was soon apparent; the eggs were imbedded in the ground, and the digging of them up had the effect only of distributing them with the soil, which, moreover, in nowise affected their fertility. Only the eggs that were exposed on the surface of the soil were destroyed by the sun scorching them up. I experimented with locusts' eggs as to the depth at which the young locust could come up through the soil if the eggs were buried without the exit hole naturally left by the female locust. I found that at a depth of ten centimetres, all found their way to the surface; at twelve centimetres, about half came up; at fifteen centimetres, none of them came through.

"If the land was unoccupied, as it generally was not, ploughing would have the effect of destroying some of the eggs, either by burying or by exposing them on the surface. No satisfactory means was found of destroying the eggs.

"Small passing flights of locusts are frequently heard of in some parts of Egypt, but give no great cause for alarm; they have lately been reported at Suakim and at Wady Halfa.

"Forty years ago the locusts stayed and bred in the country in great numbers, and were exterminated by the people in much the same manner as this year. In the present year, practically no damage was done to the crops. Where the leaves were eaten off the young cotton plants, they sprouted again almost immediately, and became bigger trees than they would have been, but bearing a smaller amount of cotton."

(iii) The Consular report for the year 1890, on the agriculture of Algeria, by Consul General Playfair, published as No. 854 of Her Majesty's Foreign Office in London; also a letter, dated 30th October 1891, by Mr. Playfair, forwarded through the Government of India; and an account which appeared in the *Daily Telegraph*.

In the middle of December 1890 flights of *Acridium peregrinum* from the south-west were noticed in several cases in the extreme south of Algeria. On 19th March 1891 again Mr. Playfair wrote—"The crickets are appearing in various parts of the colony, but especially in the department of Oran, and the Prefects are busy organising means of defence. The Governor-General has made an urgent appeal for a supplementary credit of 500,000 francs for each department. The administration seems to be doing all that is humanly possible, but so widespread is the evil that it is doubtful whether they will be able to cope with it." On 30th October 1891, however, Mr. Playfair wrote that the result of the campaign waged against the locusts had been so sucessful that but little injury had been done to the crops.

According to an account of the locusts' invasion in Algeria, published in the *Daily Telegraph* in the early part of June 1891, reports of damage by locusts were coming in daily from all parts of Algeria, and large flights were observed in the Mediterranean. The mayors of the communes in Algeria were offering rewards at the rate of one franc for each 50 lbs. of locusts destroyed. Ploughing had been resorted to for the destruction of the eggs, but vast numbers of wingless larvæ had nevertheless emerged, and were doing great damage to the crops. The Cyprus screen system was being very largely used for the destruction of these larvæ, and smoky fires were found to be the best means of preventing the winged flights from alighting on the crops.

(iv) A letter, dated 3rd November 1891, from the Consul General in Tripoli, forwarded through the Government of India, noticing that although Tunis, Algiers, and Morocco had suffered from locusts, Tripoli had escaped.

(v) A notice which appeared in the *Board of Trade Journal*, London, June 1891, p. 684, on the subject of locusts in Morocco. According to this notice, locusts were first reported in Morocco in the southern province of Soos in the end of October 1890. Thence they spread over the country, and in the spring began egg laying, causing great anxiety for the spring crops. Damage also was done to green crops, and olive and almond trees were in many places stripped of their bark. No general measures were taken to deal with the locusts, though vast numbers were collected and sold for food both to Jews and Mohammedans. The locusts were brought in from the country on camels in the form of "heaving sackfuls," of ruddy brown or greenish-yellow insects (the first colour in the autumn, the latter in the spring,. They were said to be first boiled in salt and water, and then fried or parched. The same *modus operandi* was said to have been in vogue, according to old writers, early in the last century, and when properly preserved the "Jeraad" appear to have been looked upon as a convenient form of food for travellers to take with them on the road.

Locusts in Persia.

The following report by Mr. W. Townley, on locusts in Persia, has been furnished through the Government of India by Her Majesty's Legation in Teheran. It will be interesting to ascertain the identity of the three species of locusts that are referred to in the report under the names of *Mesri*, *Daryaie*, and *Tanko*. For this purpose it would be desirable to obtain representatives of each of the species for examination by some trained entomologist. Up to the present little has been ascertained upon this

subject beyond the fact that the destructive migratory species *Acridium peregrinum* is often prevalent along the southern coasts of Persia :—

"There are no records of any flights of locusts having come as far north as the Teheran district, but it is reported from Kermanshah that locusts visit that district every five or ten years, and that visitations occasionally have taken place in two consecutive years. These locust visitations come from the Traki Arab, that is to say, from such districts as Karkoot, Suleimanieh, and Mosul. There are three distinct classes of locusts which visit the Shiraz district, and which are classified as the *Mesri*, *Daryaie*, and *Tanko*. The former always arrive from the direction of Lar and Sabeh, near the latter of which places there is a shrine called Alam Shah, where these locusts are said to come into existence, and from whence, after a few years, when their numbers have increased, they advance upon Lar Darab and Fasa. These locusts always travel from south to north, and when they have once left a place never return to it. The Daryaie locusts always appear from the direction of Bandar Abbas and Bushire, hence their name of sea-locusts. They eat nothing but the leaves of trees. The *Tanko* locusts have no wings. They live longer than the *Mesri* locusts, and their existence only terminates with the commencement of winter.

"In the hotter parts of the Kermanshah district locusts arrive about the end of March, when the fields are green, and at once set to work to devour the young vegetation. Near Kermanshah itself the locusts come out from under the ground about the middle of May. In the Shiraz district the date of the arrival of the locusts is fixed as being early in March. In the Kermanshah district oviposition takes place in the hotter regions about the end of May, and in the colder places about a month later The eggs are hatched in the Shiraz district early in March.

"No remedial measures have been adopted in Persia, either by the Government or the people, for the extermination of locusts, though in Turkey the soldiers are sometimes ordered to assist to sweep up the locusts in the early morning when they are benumbed with cold, and to throw them into holes dug in the ground which are subsequently filled in with earth ; and also in that country locusts' eggs are purchased from the peasants, and the progress of the ravages of the pest is thus largely arrested.

"Locusts and their eggs are, however, largely destroyed by the following four natural causes: (1) rain during the hot seasons; (2) want of rain in winter; (3) the fact that after a few years they cannot lay eggs, and the generation of the species thus comes to an end; and (4) excessive cold ; snow or hail kill the insects themselves if they are not grown up sufficiently to stand climatic changes. The following popular legend may also point to the starling as being a natural destroyer of the locusts. It is said that there is a spring at Kasvin, called Cheshmeh-i-Sar or the Starling's spring, and that if water is brought from this spring and sprinkled with certain ceremonies on the ground which is infested with this pest, large numbers of starlings appear and devour the locusts, thus preventing further devastation of the crops.

"The eggs of locusts are deposited at the foot of mountains or in hard places, and for 40 days after hatchings they are not provided with wings, and consequently cannot move about easily from place to place, but at the end of that period their wings grow and they set off on their flight, laying waste the fields which they pass on their way. Locusts live for 120 days, and during this short period of existence they lay eggs three times. Oviposition commences when they are 90 days old, and is repeated twice more, with an interval of 10 days each time, at the end of which three ovipositions they have reached an age of 110 days, and then after a further interval of 10 days they die. Each locust lays 90 eggs the first time, 70 the second, and 50 the third. The

locusts which are the results of the first oviposition are larger than those of the second, and those of the second oviposition are larger than those of the third. The above details as to the period of the existence and oviposition of locusts refer to those which are classified in Southern Persia under the name *Mesri* (Egyptian).

TEHERAN ;
The 19th December 1881. } (Sd.) WALTER TOWNLEY."

Locusts in Turkish Arabia.

The following notes on the locusts which have proved destructive in Turkish Arabia are of interest, as *Acridium peregrinum* (the migratory locust of North-Western India) seems to be the insect which is chiefly complained of.

According to a report by C. C. Metaxas, published in the *Revue des Sciences Naturells Apliquées*, 37, No. 12, June 1890, pages 584 to 590, reviewed in *Insect Life*, Volume III, page 172. *Acridium peregrinum* did much damage in the province of Mesopotamia in Turkish Arabia between the years 1884 and 1889, fresh swarms constantly invading the province in April from the south-east (*i.e.*, Southern Persia or Baluchistan). The early part of the winter of 1888-89 was an unusually mild one. The eggs hatched in January and the young locusts were killed by frosts in February, and it is supposed that the same conditions prevailed further eastwards, as there were no fresh invading swarms in the spring of 1889. A tax of 25 kilograms egg of capsules, to be delivered each winter, was imposed by the Turkish Government on each person in the cities, and for every plow in the country there was a similar tax of 50 kilograms. The result of these measures was that a large number of eggs were collected, and this, in conjunction with the frost in February, the failure of the spring rains which are considered essential to the hatching of the eggs, and the absence of fresh invading swarms from the south-east, resulted for the time in the cessation of the locust plague.

According to a report furnished through the Government of India from the British Residency in Baghdad, this locality is subject to invasion from two distinct species of locusts, the one coming from the district of Kerkook on the north, and the other from the direction of the Arabian deserts to the south. The following extracts from the Residency diaries are valuable as showing the nature and extent of the invasions :—

"*19th March 1886.*—The Local Government is making strenuous exertions against the locusts whose eggs the surrounding country is supposed to be full of. Yesterday both His Excellency the Wali and His Excellency the Commander-in-Chief, encamped outside the town to superintend the work of searching for eggs by detachments of soldiers. The young locusts are taken out of the ground in numbers: and in their present stage are small black wriggling creatures, something like spiders.

"*20th May 1886.*—For some time past the locusts have (while not diminishing in numbers outside) been invading the town, spoiling gardens, and entering the houses, where they have proved equally annoying to the inmates and destructive to household fittings.

"*17th June 1886.*—The locusts have now quite disappeared. The general belief is that, having laid their eggs, they have died, but it is noteworthy that no dead locusts are ever seen on the ground. This suggests the possibility of their having set off to new pastures, though it would be difficult for them to do so and escape observation.

"*11th April 1891.*—Locusts have now appeared—not from the skies, which is hardly ever the way of it in Irak, but from the ground, where their spawn has been buried, and myriads of them are now preying on the half-grown wheat and barley.

"*29th April 1891.*—The notable feature of the week is the rise of 40 per cent. in the price of wheat, owing to the extensive losses inflicted by the locusts in all the country round Baghdad."

Sulphur *versus* red spider.

A very complete and interesting series of reports by Mr. G. F. Playfair, on the results of experiments conducted in Cachar upon the subject of the sulphur treatment for red spider, have been furnished by Messrs. Barry & Co. Five tons of refined flowers of sulphur were sent up to the garden for application as a remedy against red spider (*Tetranychus bioculatus* W.M.), which is one of the tea planters' most inveterate enemies. The sulphur was applied over an area of 138 acres, and the results appear to be so successful that the treatment seems likely to prove of the very greatest value.

The method adopted was to put the sulphur into bags made of loose woven cloth and sprinkle the tea bushes by simply shaking these bags over them. In some cases the bushes were first splashed with water, but in localities where water was not easily obtainable the sulphur was applied without any previous watering. The sulphur was found to adhere fairly well, even on dry bushes, in spite of the high wind which blew both at the time that the sulphuring was going on and afterwards. The average cost of the treatment has been estimated by Mr. Playfair at ₹8-4 per acre, including the price and freight of the sulphur and the cost of application. The sulphur was applied in the first instance at the rate of one hundredweight to the acre, but a large area was afterwards sulphured at the rate of two hundredweight to three acres, and an experiment was made over eleven acres of sprinkling a mixture of one part of sulphur with two parts of sifted lime. The last application does not appear to have been so successful as the undiluted sulphur. Besides destroying the red spider most effectively, Mr. Playfair is of opinion that the sulphur treatment is also useful against the mosquito blight (*Helopeltes theiovora* Moore), which is perhaps an even more destructive pest than red spider. Upon this point it will be useful to make further observations, as mites (such as red spider) are the only pest against which

sulphur seems to have hitherto been successfully used in other parts of the world.[1]

14th March 1892.—"I am taking advantage of the present hot weather to apply the sulphur as advised by Mr. Christison, who makes a point of putting it on during times of bright sunshine. I find the quantity used is exactly one cwt. to the acre, and cost of application R1-6. Up to date I have sulphured 60 acres, and will keep on as long as the sulphur lasts, or the drought continues. I have given up my original intention of applying half now, and the balance when red spider becomes active, as I find in places a good deal of blight is already visible, and I am hopeful that the sulphur will stamp it out before the insect has time to propagate. Some experiments with the mosquito itself tend to show that it dies if lightly dusted with the sulphur."

25th March 1892.—"Red spider began to show itself all over the early pruned sections, but I applied the sulphur as fast as I could, and whenever the application was made not a trace of spider remains. Altogether 138 acres have been sulphured with the 5 tons sent up. The sulphuring has been most carefully done, either a Babu or Mr. Burns being in constant attendance, and as far as can be judged at this early stage the experiment is likely to be a very remunerative one. Whether or not the spider will come back remains to be seen, but at the present moment I can guarantee there is not a single affected bush over the whole 138 acres."

13th April 1892.—"The drought still continues, only ·86 inches of rain having fallen in April, the total to date since the 1st January being 4·05 inches. Notwithstanding, Bundookmara is looking very well and would flush at once with rain. The great heat and dryness of the soil have brought on some red spider, but not much, as the early pruned sections were all sulphured, and the later pruned have not yet sufficient foliage to make red spider harmful. It is gratifying to observe that not a single plant over the sulphured area shows the slightest sign of red spider, and blight which had appeared with the first growth has also entirely disappeared. I believe that in dealing with the one disease, we have also dealt with the other, and that the early part of the season will be free from blight."

18th April 1892.—"There have been no charges in connection with the sulphur, it having been brought up to the garden by my own boats. From the invoice, and estimating for freight, I make out the five tons have cost approximately R900 and applied to the bushes about R8-4 per acre. A very small increase in yield will cover the expense, and I am hopeful, from the look of the sulphured sections, of proving to you that the money has been well spent. You must not expect to see any very startling increase in outturn in consequence of the sulphuring, as I have naturally treated those flats which are the poorest and most in want of encouragement, but if by doing away with spider and possibly blight, I can in time bring these flats from poor to good; the gain will be great indeed. At the present moment I believe that the application of sulphur will result in an increase of a maund of tea per acre; it certainly will be so if blight is mitigated as well.

"I have written out extracts from my diary giving you full particulars respecting

[1] It may be noticed that washes made of soap and sulphur combined have been recommended both in the United States and in England for use against mites like the *red spider*. The wash is sprayed on to the plants by means of a force pump fitted with a nozzle to give a very finely divided spray. This method of applying the sulphur may possibly prove cheaper and more effectual than dusting it on to the leaves, though Mr. Playfair's experiments with sulphur in powder seem so successful as to leave little to be desired. Compounds of soft soap and sulphur can now be purchased in England ready made, so as only to require the addition of water. In her fifteenth annual report on Injurious Insects, Miss Ormerod mentions the Chiswick Soap Co., of Chiswick, England, as a firm from which the mixture can be procured.

the way the sulphur was applied, the state of the bushes before, and the immediate result after application. It will be interesting to compare this report with subsequent ones which I will send from time to time in the same form."

Abstract of Diary.—"The treatment was begun on 7th March 1892 and completed on 21st of the same month. Sixty acres were treated at the rate of one hundredweight to the acre, which gave a very sufficient sprinkling, sixty-seven acres at the rate of two hundredweight to three acres, while eleven acres were treated with a mixture of one part of sulphur to two parts of sifted lime. The tea that was treated was of the "China" variety. The bushes were rather below than above the medium size. They had not put out much growth owing to the drought. Red spider had appeared, and careful examination showed that it was present in many places. The application of the sulphur was made through *markin* cloth by simply shaking the bag over the bush. Where water was available the bushes were first splashed with water, but over a considerable area the application was made without previous watering. The sulphur adhered fairly well even on dry bushes, in spite of the high wind which blew both at the time that the treatment was going on and afterwards. The average cost of applying the sulphur was about ₹1-4-9 per acre, including the purchase both of the cloth and also of the *kulcies* for watering. As far as could be made out, *provided the sun was strong*, bushes powdered in the morning had all the red spider killed by evening. After sulphuring the bushes were examined daily, but the only bushes on which red spider could be found were one or two, which had been treated with the mixture of lime and sulphur; even here, however, very careful search was required to find live insects. On 16th April it was noted that red spider was to be seen in all parts of the garden except the sulphured area, while neighbouring gardens were very much affected by it. The sulphured area was the first pruned and, should, under ordinary circumstances, have been the most affected. With regard to the effect of the sulphur treatment on mosquito blight, some mosquito blight insects were caught and experimented with on 23rd March. When sulphur was powdered on to them it adhered to the hairy parts of the body and legs to a considerable extent, but the insects did not die at once, though putting them in this state under a glass in the sun was fatal to them. After applying the sulphur all signs of blight disappeared, careful search not revealing a single punctured shoot. It must be added that little blight could be found on other parts of the garden but the flats which had been treated with sulphur were always the ones to be first attacked."

6th May 1892.—"I have no objection whatever to Mr. Cotes making use of any information he may have derived from my writings, and will be glad to supply him with further notes from time to time. I strongly object however to trying Mr. Cotes' suggestion about sulphur soap instead of the pure sulphur (except as a supplementary experiment) for this reason.

"The action of sulphur against red spider is now proved beyond doubt, and requires no comment. It also seems to have killed off the blight insect; and if this is a fact it would be a vast pity to operate against the one disease without the other in future, for the sulphur soap wash however efficacious against spider could not be expected to do much harm to a winged insect like blight. Moreover, the wash requires special apparatus for application, and the purchase of such in sufficient quantity to go over hundreds of acres quickly would be prohibitive. That blight has actually been killed out over the sulphured area seems to me a certainty. On the 14th March I wrote to you saying that my original plan of distributing the sulphur had been changed owing to a considerable amount of blight being noticeable. This is proof that blight *was* there; it is equally certain there is none *now*, and the accompanying extract from my Diary will prove that during the past ten years I have invariably reported blight not later than the week ending the 23rd April, and almost always in the same spot, which this year is free. I am not yet in a position to ask you for a further and larger supply of sulphur

for next year, but trust to be able to do so when I can lay the result of the pluckings of the sulphured and non-sulphured areas before you."

Tomato decoction for red spider.

An experiment in applying an insecticide, formed of a decoction of tomato leaves, for the destruction of *red spider* (*Tetranychus bioculatus* W. M.) on tea bushes, has recently been recorded in the publications of the Agri.-Horticultural Society of Calcutta. The experiment was made by Mr. W. Weston of the Senigell Tea Company in Assam, and the results, so far as the experiments went, seem to have been to some extent encouraging, though the labour required was very great, and the cost was much heavier than in the case of the sulphur treatment described in the preceding section.

The decoction was tried upon a small scale, and Mr. Weston found that it thoroughly extirpated the red spider, without injury to the tea bushes. The treatment had no effect upon the yield of the bushes, for it was found that, as long as a tea bush is suffering from red spider, it does not flush, and as soon as the pest is destroyed the treatment can be discontinued.

A number of applications were found necessary to destroy the blight, some of the bushes being sprayed, morning and evening, for from eighteen to twenty-seven days before blight was killed; eventually, however, the blight was effectually destroyed. The cost of the treatment was considerable, one hundred and thirty rupees being the estimated cost per annum of destroying the blight on one acre of infested tea; but as red spider is found to start on a few bushes, whence it spreads over a garden, Mr. Weston expects that by keeping a sharp look-out and using the decoction to destroy the blight on the bushes, where it first appears and before it has time to spread, there will be no need to spray any considerable area.

The directions for preparing and applying the wash are given as follows:—

"Take 80 lbs. of tomato leaves and stalks (bine), throw a portion into a cask, and pulp well with a long wooden mortar. Continue adding till the whole of the 80 lbs. is pulped; then add 40 quarts of water and mix well. The decoction is now ready for use. Old leaves and bine which are stringy are useless.....The best and quickest method of applying the decoction is with syringes with rose heads. Syringe the bush thoroughly morning and evening."

The tomato plant grows with great freedom, so a supply of the materials for making the insecticide is said to be readily procurable.

There has long been a tradition that the tomato plant has certain insecticide properties, but the few records that have been published of attempts made in America to utilize tomato decoctions as insecticides

have been so unfavourable that it is not surprising the plant has attracted but little attention in this connection. It will be interesting therefore to ascertain whether subsequent experience confirms the favourable opinion formed of the decoction by Mr. Weston.

London purple insecticide in Madras.

A small quantity of some London purple, supplied to the Indian Museum for experiment by Messrs. Hemingway & Co., of London and New York, also a force pump similarly supplied for experiment by Messrs. Rumsey & Co., of New York, were forwarded to the Madras Museum in January 1889 for experiment upon the caterpillar *Achæ melicerte* Drury, which was reported as doing a considerable amount of damage to castor oil plants in the Madras Presidency. The insecticide seems to have reached Madras too late for use against this caterpillar, but a report has been furnished, through the Madras Board of Revenue, of some experiments made with it by the Government Botanist in July 1891. These experiments were made upon scale insects, red spider, and Aphidæ, for which London purple is not usually recommended, as they all feed by drawing up the juices of the plant through a narrow proboscis which is inserted into the tissues of the leaf or shoot. They are therefore little effected by a poison like London purple, which usually requires to be taken into the stomach, though cases have been found, as for instance, that of the leaf hopper which attacks mango blossom, where it is effective against haustellate insects. It is to be hoped that in the further experiments which it has been proposed to make in the College of Agriculture, Madras, attention will be chiefly directed to mandibular insects, such as caterpillars and beetles, which eat the substance of the plants and are thus likely to take the London purple into their digestive organs.

The following is an extract from the report furnished by the Government Botanist, on experiments made with the force pump and London purple furnished to the Madras Museum :—

"The results have not been so satisfactory as I expected; a strong solution failed to kill scale; a weaker solution proved destructive to red spider and aphids, when the fluid was brought in contact with them; but the insects on the under surface of the leaves were often untouched by the spray and so escaped. The stronger solution killed the leaves of the plants to which it was applied. The solution itself is no doubt a useful insecticide, and it is the method of applying it only which is not quite satisfactory, as the pump is not suited for directing the spray to the under surface of the leaves."

Sugarcane borer.

An interesting report on the sugarcane borer (*Diatræa saccharalis* Fabr.), by Mr. L. O. Howard, appears in *Insect Life*, Vol. IV, page 95, Washington, 1891.

After a careful review of what has been ascertained about this destructive insect, Mr. Howard concludes that it attacks all four of the closely related species of plants *Sorghum vulgare, Saccharum officinarum, Tripsacum dactyloides*, and *Zea mays* in the United States. Mr. Howard adds—

"The brown spots on the midsummer individuals in corn [1] in South Carolina and Virginia affords no argument for the non-identity of the sugarcane and corn borers. Moreover, specimens from sugarcane from Florida collected in October of the present year show the brown spots and variation of the colour of head and prothoracic shield noticed in corn specimens, and are in fact indistinguishable from these. In addition to this, from my observations in Westmorland country Va., the past August, it seems probable that the loss of the spots is characteristic of the perfectly full-grown larva, as at this late date the few delayed individuals of the first brood are all white." In a foot-note Mr. Howard adds—"Professor Riley, who has examined the moths, both from corn and sugarcane, since the above was written, finds that they all belong to one species. Of over fifty specimens reared there is great variation both as to the distinctness of the transverse lines and of the terminal series of dots, and as to the general ground colour. It is also noticeable that the later-bred specimens from the south are, on the whole, darker. The males are generally much darker than the females. The material leaves no question that *obliteratellus* Zeller, and *crambidoides* Grote, are, as they have been made by Professor Fernald, merely synonyms."

The question of the specific identity of the borers which attack *sugarcane* (*Saccharum officinarum*), *cholum* (*Sorghum vulgare*), and *maize* (*Zea mays*) is an important one in India, where they do a great deal of damage to all three crops; and it is very desirable to settle definitely to what extent the refuse of sugarcane (for instance) is liable to breed moths that will lay their eggs in fields of cholum or maize that happen to be in the neighbourhood.

A number of moths have been reared in Calcutta from affected sugarcane that has been sent to the Indian Museum, and though they differ from each other a good deal both in size and coloration, they seem likely to prove to be merely varieties of one species. Moths also have been reared in the Indian Museum from caterpillars found in maize, and these also seem without doubt to be identical with the moths reared from sugarcane. In the case of cholum, a number of infested stalks were sent to the Museum, but the attempts that were made to rear the moth were not successful, owing to the fact that almost all the caterpillars were found to be suffering from the attack of a chalcid parasite [2] which proved fatal to all its victims. As far as could be made out the caterpillar was the same as the one found in sugarcane. It is interesting to notice, in this connection, that, owing to the fact that it is always

[1] Corn = *Zea mays*, Ed.

[2] Since described by Mr. Peter Cameron as *Cotesia flavipes n. sp.*, see Mem. Manchester Lit. and Philos. Soc., 1891.

much easier in Calcutta to procure sugarcane stalks than either sorghum or maize stalks, sugarcane was used for rearing the borers sent to the Museum as attacking both maize and sorghum. Borers taken out of maize shoots were reared in sugarcane from the time they were comparatively small caterpillars until they emerged as moths, and a sorghum borer (the only one of a set received from Poona that escaped the chalcid parasite) was reared in sugarcane from the time it was a half-grown caterpillar until it reached the chrysalis stage, when it was accidentally injured and thus prevented from emerging as a moth. The caterpillars taken both from maize and sorghum stalks seemed none the worse for being fed upon sugarcane, and this appears of itself to be a strong reason for supposing that the three insects are identical. It would settle the point however if it should prove that the American species which has now been shown to attack all three plants is also the one that occurs in India, and a moth therefore, reared from sugarcane in Calcutta, has been sent to Washington for comparison with the specimens that have been reared in the United States[1].

Grain storage to exclude weevil.

The following letters, furnished in response to inquiries made by the Director of Mines and Agriculture in New South Wales, on the subject of the methods adopted in Australia and the United States for protecting grain from weevil, are of interest in view of the great injury done by grain weevils in India.

In the October number of the *Agricultural Gazette* of New South Wales (Sydney, 1891), the Under-Secretary to the Queensland Department of Agriculture writes—

"The system of storing maize in tanks has been in vogue in this colony for some time past, but I am not aware, nor have I heard, that the tanks are made of steel. Tanks of various kinds and shapes have been used, from the square 400-gallon ship tanks to the round corrugated-iron tank of the cottage; then, again, tanks of galvanized iron have been specially constructed, having a capacity to suit the amount of grain to be stored. Several of our farmers have tanks of a capacity of 1,000 gallons in use, some even being larger, and fitted with traps at the bottom to facilitate discharge when bagging. Different methods of securing the keeping qualities of the

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[1] In reply Dr. Riley, the United States Entomologist, writes: "I must confess that I am rather disappointed in finding that your sugarcane borer is not the same as ours. It is a *Chilo* and not a *Diatraea*, and comes near *C. plejadellus* Zinck. which bores into rice in our Southern States, but it differs in the very clear cut terminal dark line between the black spots and fringe. The specimen is badly rubbed, and I cannot be certain of its exact specific position. It is possible that it may be identical with *Chilo infuscatellus* Snell., which infests sugarcane in Java.....I believe that you are perfectly right in assuming that the borers in sugarcane, sorghum, and maize are all the same, and it is interesting to know that at least one other crambid agrees with *D. saccharalis* in this particular."

grain are adopted: (1) thorough kiln drying is resorted to prior to putting the grain in the tanks; (2) bisulphide of carbon, the use of which does not injure the grain, being of a very volatile nature the fumes soon pass away; (3) the placing of a small piece of candle lighted on the top of the grain and then screwing the lid down very tight, the object being to secure an air-tight chamber. The two latter methods are most in vogue, and *are most successful in their results*, the grain keeping perfectly for a period. Although this system of storing grain is adopted in several districts in this colony by farmers, yet that part of the colony where it has been most largely resorted to is what is locally known as the Isis scrub, in the Bundaberg district."

In the December number of the same periodical, Mr. O. Clute, President of the Agricultural College of the State of Michigan, United States, America, writes—

"I have had no experience or observation as to storing grain in metal cylinders or tanks, hence can give you no information on this point. I do not think this method is much followed in the States. The attacks of the weevil and some other insects have been of serious character in some parts of America, resulting in great pecuniary loss. A method of destroying such pests, and of protecting mills, granaries, elevators, etc., against their ravages, was tried by the experiment station a few years since. It has now been used by large millers and dealers in grain with perfect success, and we recommend it with confidence. As it can be used in any ordinary building, at a comparatively light cost, it seems to me better than metal tanks or cylinders. Indeed the metal tanks can give no protection unless you are sure that the grain is free from eggs when it is put in, and then that the tanks are hermetically sealed, so as to prevent the insects from getting at the grain and laying eggs.

"We use bisulphide of carbon, which rapidly evaporates, and makes a dense vapour, which settles down through the grain and penetrates to every crack.

"The method of application adopted in America is to close up the room or store as nearly air-tight as possible immediately after having sprinked the bisulphide over the grain, at the rate of about 1½lb. to the ton, when, being heavierthan the air, its vapour sinks down through every interstice. This carbon bisulphide is not so injurious to human life as some other vapours, but it is very explosive when mixed with air, and therefore great care should be taken not to bring a light near when it is being applied. It evaporates so quickly that it can be thrown on any grain without injuring it in any way. After opening the can in which the bisulphide is received, no time should be lost in using, but the contents should be at once scattered in the bins, and the doors or covers closed as quickly as possible, and kept closed for 24 hours, to give time to the vapours to act and reach every corner."

In the January number of the same periodical (1892) the Editor writes—

"The following information and accompanying plan are results of further inquiries by the Department in connection with various methods for the safe storage of grain:—Steel tanks were recommended, and an application was therefore made to Messrs. Hudson Brothers (Limited) for designs, together with their quotations as to cost. It will be seen that the design supplied shows two sizes, with provision for fumigation. They would be built of steel plates, and the estimated prices are, for the smaller size, £99 15*s.* complete, free on rail at Granville; and for the larger, £465, in sections ready to put together, also free on rail at Granville. On receipt of these documents the Director wrote, pointing out that the prices quoted were beyond

the reach of farmers of ordinary means, but thanking them for the drawings, which would be reproduced in the Gazette, in order that agriculturists might become acquainted with the scheme, and that in course of time a demand might arise if the prices could be lowered. In reply to this letter Messrs. Hudson wrote, explaining that the prices could be but little, if at all, improved upon for receptacles of the capacity named ; smaller tanks, if of any service, could be made at a reduced cost nearly in proportion to diminution of size. The quotations are for best material and workmanship, as the weight of grain would be considerable, but Messrs. Hudson expressed themselves as being willing to consider any suggestions for a cheaper form of tank.

"In reply to communications by the Department, two further letters have been received from America : one from the United States Department of Agriculture at Washington, and the other from the State Agricultural College of Texas, both intimating their inability to give any information regarding the use of steel tanks for grain storage."

Contagious disease germs *versus* insects.

The contagious diseases which attack insects have lately been attracting a good deal of attention, and some interesting papers have been published in the periodical *Insect Life* (United States Department of Agriculture, Washington, 1890-91) on the subject. It has long been known that silkworms, house flies, and clinch bugs are very subject to the attack of contagious diseases, and various other insects also are said to suffer to a considerable extent. The question therefore is an important one both on account of the possible utilization of these diseases in fighting insect pests, and also in connection with the obscure subject of the causes which produce the undue multiplication at one time and the undue suppression at another of common species. These being marked features of insect life in India as in other parts of the globe.

In Algeria MM. Künckel and Langlois have been experimenting with a cryptogamic disease (*Lachnidium acridiorum*) said to attack migratory locusts in Africa (vide *Insect Life*, Vol. IV, p. 151 ; and Bull. Soc. Ent. Fr., 24th June 1891). In France Messrs. Fribourg and Hesse of 26 Rue des Écoles, Paris, are advertising for sale spores of a vegetable parasite which they claim can be used for the destruction, by inoculation, of white grubs (Melolonthidae), *vide* Insect Life, Vol. IV, p. 152 ; while an interesting series of investigations have been carried on in the United States by Mr. F. H. Snow, who has been experimenting with the diseases to which the clinch bug (*Blissus leucopterus*) is subject.

In a paper read before the Committee on Entomology of the Association of American Agricultural Colleges and Experimental Stations held at Champaign Illinois on November 12th, 1890, and subsequently in a paper which appeared in Insect Life, Vol. VI, page 69, Mr. F. H. Snow describes his experiments in infecting healthy clinch bugs by scattering diseased individuals amongst them. Mr. Snow's experiments were conducted upon a considerable scale, and he regards the results upon the

whole as satisfactory. The method adopted was very simple. It consisted in shutting up healthy clinch bugs for a few hours in a jar containing diseased individuals. The insects thus infected were scattered broadcast over fields infested with the pest, with the apparent result of a great spreading of the disease and a consequent diminution in the numbers of the clinch bugs. The diseases which were disseminated were of several kinds. They included a bacterial disease due to an organism identified as *Micrococcus insectorum* Burril, and at least two distinct fungoid diseases. Of these diseases the *Micrococcus* has long been known to attack the clinch bug (*vide* Cruickshank's Introduction to Practical Bacteriology, London, 1886), and it is probably one of the most important. It is described in a paper by Professor A. S. Forbes, quoted in Insect Life, Vol. IV, p. 88. Professor Forbes found that it attacks a portion of the digestive tract of the insect, and that, at one time, it was so universally present that he was unable to find any unaffected clinch bugs for experiment in connection with the fresh inoculation of the disease. This feature, in connection with the necessary liability to error in evidence upon so technical a subject collected from farmers in the field, would seem to indicate that the subject will require a good deal more investigation before any very certain conclusions will be justifiable as to the practical results to be expected from the methods adopted by Mr. Snow. In this connection Professor Forbes writes (*North American Practitioner*, September 1891, quoted in Insect Life, Vol. IV, p. 88)—

"Concerning the utilization of artificial cultures of Micrococcus for a propagation of this disease among insects not affected, I am at present able to say but little, as I have not yet succeeded, in either season when it was common, in finding lots of clinch bugs sufficiently free from it to make them suitable subjects for experimental attempts at its transfer. It will be readily understood by any one that it is useless to test the utility of artificial cultures of the disease germs by applying them to insects which are already affected by the disease in question. The first step of any really scientific investigation of the economics of this matter is to determine positively the absence of the disease in the lots of insects to be used in the experiments. Every lot of clinch bugs thus far obtained by me from Central, South Central, and Northern Illinois during the months of July and August of this year, gave evidence, under critical study, of the presence of this microbe in the cœca of a larger or smaller percentage of pupæ and imagos. My previous observations—less carefully made, however, than my recent ones—have been to the general effect that hibernating clinch bugs and young preceding the so-called pupa state are little liable to the spontaneous occurrence of the intestinal trouble, and I consequently do not despair of finding, before the present season is over, opportunity for experiments which will determine beyond question the economic value of this clinch bug cholera."

The following extracts are taken from the reports of Mr. Snow's papers upon the subject as published in *Insect Life*, Volumes III and IV:—

"As Entomologist to the Kansas State Board of Agriculture I had prepared an article for the annual meeting of that Board in January 1889, stating what was

known at that time upon the subject, and calling attention to the investigations of Professors Forbes, Burrill, and Lugger. In June 1889 a letter was received from Dr. J. T. Curtiss, of Dwight, Morris county, Kansas, announcing that one of the diseases mentioned in the article (Entomophtora) was raging in various fields in that region, and stating that in many places in fields of oats and wheat the ground was fairly white with the dead bugs. Some of these dead bugs were at once obtained, and experiments were begun in the entomological laboratory of the university. It was found that living, healthy bugs, when placed in the same jar with the dead bugs from Morris county, were sickened and killed within ten days. A Lawrence newspaper reporter, learning of this fact, published the statement that any farmers who were troubled by clinch bugs might easily destroy them from their entire farms by sending to me for some diseased bugs. This announcement was published all over the country, and in a few days I received applications from agricultural experiment stations and farmers in nine different States, praying for a few 'diseased and deceased' bugs with which to inoculate the destroying pests with a fatal disease. Some fifty packages were sent out during the season of 1889, and the results were in the main highly favourable.

"It was my belief that sick bugs would prove more serviceable in the dissemination of disease than dead bugs. I accordingly sent out a circular letter with each package, instructing the receiver to place the dead bugs in a jar for forty-eight hours, with from ten to twenty times as many live bugs from the field. In this way the disease would be communicated to the live bugs in the jar. These sick bugs being deposited in different portions of the field of experiment, would communicate the disease more thoroughly while moving about among the healthy bugs by which they would be surrounded. This belief was corroborated by the results. The disease was successfully introduced from my laboratory into the States of Missouri, Nebraska, Indiana, Ohio, and Minnesota, and into various counties in the State of Kansas. A report of my observations and experiments in 1889 has been published in the Transactions of the Kansas Academy of Science, Vol. XII, pp. 34-37, also in the Report of the Proceedings of the Annual Meeting of the Kansas State Board of Agriculture in January 1890.

"The next point to be attained was the preservation of the disease through the winter, in order that it might be under my control and be available for use in the season of 1890. To accomplish this result I placed fresh, healthy bugs in the infection jar late in November 1889, and was pleased to note that they contracted the disease and died in the same way as in the earlier part of the season. I was not able to obtain fresh material for the purpose of testing the vitality of the disease germs in the spring of 1890 until the month of April, and then only a limited supply of live bugs could be secured. I quote the following from my laboratory notes:—

"April 10th, twenty-five clinch bugs that had hibernated in the field were put in the infection jars. They were supplied with young wheat plants. The bugs appeared lively and healthy.

"April 16th, some of the bugs were dead, and all appeared stupid.

"April 20th, all of the bugs were dead.

"One week later a new supply of fourteen bugs was put into the jar; they were supplied with growing wheat. They ran substantially the same course as the first twenty-five. Some had died at the end of the first week, and all were dead by the end of the thirteenth day.

"The clinch bug seemed to have been very generally exterminated in Kansas in 1889, and only three applications for diseased bugs were received in 1890 up to the

middle of July. On account of the limited amount of infection material on hand, I required each applicant to send me a box of live bugs, which I placed in the infection jars, returning in a few days a portion of the sick bugs to the sender. The three applicants above noted reported the complete success of the experiments.....

"Before the close of the season of 1890 it became evident that there were at least three diseases at work in our infection jars, the white fungus (*Entomophthora* or *Empusa*), a bacterial disease (*Micrococcus*), and a fungus considered by Dr. Roland Thaxter to be *Isaria*, or perhaps more properly *Trichoderma*.....

"The following is a summary of the results of the field experiments in the season of 1890:—

"Number of boxes of diseased bugs sent out, thirty-eight. Seven of these lots were either not received or received and not used. Reports were received from twenty-six of the thirty-one remaining cases. Of these twenty-six reports three were unfavourable, nineteen favourable, and four doubtful concerning the success of the experiment. These doubtful cases are not to be looked upon as unfavourable, but more evidence is needed to transfer them to the list of favourable reports. Thus nineteen out of twenty-six reports, or 73 per cent., were decidedly favourable. The experiments will be continued during the season of 1891. In presenting this paper I wish to acknowledge the invaluable aid continually received during the progress of the work from my assistants, Messrs. W. C. Stevens and V. L. Kellogg.

"The laboratory experiments have been continued through the season. Of the three diseases identified, that produced by the Trichoderma appears to be less fatal than the other two.....

"To Mr. Riley's question as to which of the three diseases mentioned was most common in destroying the bugs in the field experiments, Mr. Snow said during the dry summer of the present year he thought the bacterial disease did most of the work, but in 1889 he thought the fungous disease were most destructive.

"Mr. Riley said that the fact that Mr. Snow had been able to carry healthy bugs through the season without infection in the same room with diseased bugs was a rather discouraging one, as it would indicate either that the germs were easily kept from reaching the bugs or that they were not carried long distances. Close proximity to, or actual contact with, diseased individuals, if necessary, would materially lessen the value of their use in the field, while the evidence of farmer's experience in the field needed very careful weighing, because of the possibilities of error. Mr. Snow said that it had been found by his experiments that the diseases would spread over large fields and destroy nearly all the bugs within ten or twelve days after the diseased bugs had been introduced, and that the expense was very light" (Insect Life, Vol. III, pp. 279-285.)

"In response to your circular letter asking for notes of work done in economic entomology during the past year (1891), I beg to submit the following brief and incomplete account of the work done in Kansas this year under my direction in the matter of the artificial dissemination of a contagious disease or diseases among chinch bugs:

"The legislature of the State of Kansas at its last session in the winter of 1890-91 made an appropriation of 3,500 dollars, available during the year 1891-92, for the purpose of carrying on these experiments. With this money I have been enabled to largely increase the facilities of my laboratory, and to conduct on a rather extended scale practical experiments in the field. According to a provision in the act of appropriation, I am required to make a monthly report to be printed in the official

State paper of Kansas, the *Topeka Daily Capital.* From my last report, made on July 15, I quote as follows:—

"Since making the last report, June 15, the wheat has ripened and mostly been harvested. The clinch bugs at harvest time left the wheat fields and invaded the fields of young corn. The experiments of 1889 and 1890 were carried on among bugs in the corn-fields, and the experiments of this year in wheat fields are thus new features in the work. The results have been gratifying, but the reports from this year's corn fields and the investigations of my field assistant, Mr. Hickey, show that the massing of the bugs in the hills of corn offers more favourable conditions for the successful workings of the disease than the usual conditions incident to the presence of bugs in wheat.

"The hatching and appearance of the young bugs is a feature in the work added since the last report. It is with satisfaction that I note the communicability of the disease from old to young bugs by contact. The young bugs are as susceptible to the infection as the old ones.

"The part of the State reporting bugs in the corn-fields lies between 96° 30′ and 98° 01′ west longitude; or between a line drawn through Marshall, Pottawatomie, along the eastern boundary of Geary, Morris, Chase, and along the eastern boundary of Greenwood, Elk, and Chautauqua Counties, and a line drawn along the eastern boundary of Jewell, Mitchell, Lincoln, Ellsworth, Rice, Reno, Kingman, and Harper Counties. This bug-infested belt extends clear across the State from north to south. Scattering reports of the presence of the bugs are in from various eastern counties, and from a few west of the 98° 30′ line.

"Up to date (11A.M., July 15) infected bugs have been sent out from my laboratory to 1,700 applicants. To several of these applicants second lots of infected bugs have been sent, owing to failure to use the first lot for various reasons, and occasionally because of failure to get good results from the first experiment. But as many, if not more, persons have got dead bugs from fields wherein the bugs are dying because of infection sent out from my laboratory as have received bugs directly from me. Each successful field experiment has been the means of establishing a secondary distributing centre. It is evident that the experiment of killing clinch bugs by infection with fungoid and bacterial disease is being given a trial on a large scale. The reports for the past month (June 15 to July 15) have been gratifying, in that they show a good percentage of success. However, reports are not made out as carefully as they should be, and worse, many experimenters make no reports. I desire to have a report on every lot of infected bugs sent out.

"Because of the difficulty of getting careful reports from the field, I sent out Mr. E. C. Hickey, an intelligent University student doing special work in natural history, as a field agent. Mr. Hickey's last trip was through Chautauqua, Harvey, Sumner, Cowley, Butler, Greenwood, and Elk Counties, lasting from June 12 to July 6. He visited seventy-two persons who had experimented with infected bugs, and found over 80 per cent. of the seventy-two experiments successful. Mr. Hickey personally visited the corn-fields, and verified by careful observations the statements of the farmers.

"The laboratory facilities for sending out infected bugs have been largely increased, and all demands can be promptly met. Application for infected bugs received in the morning's mail are answered with bugs and directions on the noon outgoing trains. The work of scientific investigation in the laboratory is going on steadily and carefully. Inoculation experiments from pure cultures of *Sporotrichum* will be reported on next month. A feature of the work unnoticed previously in this report is the prevalence of *Empusa*, the fungus with which the first successful

experiments were conducted. *Empusa* and *Sporotrichum* develop side by side in the infecting cages, and dead bugs sent in from fields where the bugs are dying show both fungi. At the close of the season I hope to present a full report of the laboratory investigations, which the brief mo nthly reports offer no space for. Professor S. A. Forbes, the eminent State entomologist of Illinois, who has experimented in his laboratory on the development of parasitic fungi in insects, and who early noted the bacterial disease of the clinch bugs, visited my laboratory last week. He expressed the hope that a series of field experiments, such as are now being carried on in Kansas, could be conducted in Illinois.

"In closing, I may say that the outcome of the work so far this year is highly encouraging."

"Since making this report the requests for infected bugs have grown much less numerous. The laboratory experiments have been carried on with more attention paid to bacteria. So far I have been unable to successfully infect bugs in the laboratory from pure cultures of *Sporotrichum*. The *Sporotrichum* grows readily on a medium composed of beef broth and Irish moss, and pure cultures are easily obtained. Other experiments with these cultures are necessary, however, to make this statement positive. *Empusa* will not fruit on the plates. It behaves very peculiarly. Long erect filaments are sent out strikingly different from the customary hyphæ, but no spores are produced. As regards the bacteria, I am assured that the forms in my cultures are identical with Burrill's *Micrococcus insectorum*, two slides of which have been furnished me by Professor Forbes. This *Micrococcus* is found almost without exception in bugs which have died in the field and been sent in for examination. Another Micrococcus, larger and almost perfectly circular in optical plane, is often present in dead and dying bugs. Spraying experiments with fluids containing this Micrococcus give no successful results in infection." (Insect Life, Vol. IV, pp. 69-71.)

Fertilizers *versus* insects.

Gas lime and lime have long been recommended against root-feeding insects, and in a recent Bulletin of the new Jersey Agricultural College Experiment Station, Mr. J. B. Smith advocates kainit and muriate of potash for a similar purpose. Mr. Smith writes—

"The use of commercial fertilizers is becoming more general each year, and each year the farmers are considering more closely what material to buy to obtain the best results on their own land, and also the form in which the needed element is to be applied. Wherever it can be profitably done, potash should be applied in the form of kainit, and nitrogen in the form of nitrate of soda. I am not recommending these substances as in all cases the best fertilizers, nor would I be understood as condemning other forms of these elements. From the standpoint of the entomologist they are the best, because they have undoubted insecticide properties.....During the season of 1890 I found in a fine peach orchard several trees undoubtedly infested by root lice. I directed the application of kainit in a trench, and the new foliage was normal. A neighbour, observing the process, doctored some of his own trees, improving the treatment by adding nitrate of soda, one quart of each per tree. The result was striking, showing that the nitrate had acted as a stimulant, and had probably also aided in the destruction of the aphids.....Potash is a necessary element of food for corn, and if, in supplying the potash, kainit be used, injury will be almost entirely prevented. Muriate of potash is also effective, but less so than kainit. The evidence of all the farmers now using kainit for corn, and with whom I have talked

on the subject, is to the one purpose—since they have used the potash salts the corn has been practically exempt from injury by cut-worms or wire-worms. That kainit will kill even true wire-worms (Elater larvæ) I have proved experimentally. It does not act very promptly, but it does kill eventually, as the following proves :—

"A large number of wire-worms were divided into two lots, nearly equal in number and similar as to size, and each lot was put into a large jar with about six inches of soil. A potato, cut into quarters, was put into each jar, just beneath the surface and close to the edge, to facilitate observation. Into one jar was put two ounces of clean water ; into the other an equal amount, in which kainit at the rate of one ounce to one pint had been dissolved. No other treatment was given. For a week there seemed no difference, and most of the larvæ were buried in the potatoes. Then the younger larvæ in the kainit jar began to die, and in two weeks scarcely a living larva was to be found. In the other jar the larvæ lived on for more than a month without either food or attention, and they were then thrown into alcohol as specimens. Therefore I advise the application of kainit as a top-dressing, just as soon as the ground is ready to receive it, and as long as possible before planting."

The following is added as a foot-note :—

"Bulletin No. 33 of the Cornell station has come into my hands since this bulletin was sent to the printer. In it Professor Comstock reports poor success in laboratory experiments with kainit as against wire-worms. Space is lacking here to go into details ; but I will do so in the Annual Report. That laboratory experiments do not always indicate what will happen in the field, the following will show :—

"On the Voorhees farm, in Somerset county, a fourteen acre field was divided into two sections, to test kainit and muriate of potash as fertilizers, and a strip of seven rows was left untreated between. The land was known to be badly infested by wire-worms and cut-worms or grub-worms, more specially one low meadow. In the half treated with kainit, the corn all came up well, and was not molested by insects at all ; on the muriate half the injury was much lessened, and in the untreated rows, running the full length of the field, almost the whole was destroyed by the insects. The experiment was not made to test insecticide effect; but the results were so apparent that Mr. Voorhees spoke of them at once, and reports that since using kainit he has no further trouble with either wire-worms or cut-worms. This has also been the experience of his neighbours, and of all who have been questioned by me. I therefore again repeat my advice,—use kainit wherever practicable."

Prevention of insect ravages in England.

An interesting report on "Methods of preventing and checking the attacks of insects and fungi" (John Murray, 1891), by Mr. Charles Whitehead, has recently been published in England.

The methods recommended are generally such as are already well known in the United States, where so much has been done to develope this branch of agricultural knowledge, but Mr. Whitehead's practical little pamphet will be useful for reference, not only in England, but also in India, where people are only beginning to appreciate the importance of utilizing the latest discoveries in the methods of combating the various pests that attack crops.

For checking *wire* worms and *Tipulidæ* larvæ, which are often very

destructive to the roots of clover and other crops in England, Mr. Whitehead recommends ploughing gas lime into the land when the crop is off the ground, while soot, guano, nitrate of soda, salt, and rape dust are all recommended as top-dressings to the plants.

Emulsions of kerosine and soap are recommended for spraying plants attacked by the onion fly, the celery fly, and the carrot fly, also for the destruction of aphids of all kinds, including the corn aphid and the hop aphid. Washes made of soap and extract of quassia chips are also recommended in many cases for the same purposes as kerosine and soap emulsion. With the hop aphid in particular this system of treatment seems to have been largely adopted, and a great many machines for applying it have been invented.

For the *mite* which attacks currant bushes, washing the bushes with compounds of soft soap and sulphur is recommended; a compound of soap and sulphur, sold ready prepared for the purpose by Messrs. Burford of Chiswick, being particularly noticed.[1]

For the turnip beetle, dressing the plants with lime, soot, guano, and kerosine emulsion are all recommended.

Hellebore in powder or solution destroys saw fly which attacks gooseberry bushes, but care in handling it is insisted upon, as it is very poisonous.

Spraying with such arsenical washes as London purple and Paris green, is recommended for the destruction of the numerous caterpillars which defoliate fruit trees, though this treatment does not appear as yet to have been very widely adopted in England, as there is a prejudice against it on account of the poisonous nature of arsenical insecticides.

In the case of the caterpillars of the winter moth, the codlin moth, and the apple-bud weevil, protruding rims of tin or bands of sticky or impenetrable substances are recommended for fixing round the trunks of the trees to prevent the insects climbing up to lay their eggs, while white-washing the trunks and branches of fruit trees in the autumn, is also said to be useful, as it destroys the lichen and dislodges many insects which would otherwise find shelter either for themselves or for their eggs in the bark.

In the case of the *Phylloxera* of the vine, flooding the vineyards, injecting bisulphide of carbon into the ground close to the vines, and introducing American vines, which are not so subject to attack, are quoted as having been largely adopted in France.

For distributing insecticides a large number of machines are described, very many of them no doubt excellently adapted for the purposes for which they have been designed. About the two most generally useful

[1] This preparation would probably be useful against red spider on tea.

ones seem to be the "*Strawsonizer*" for distributing applications over fields and other large areas, and M. Vermorel's Éclair Knapsack pump (price about thirty-five shillings) for handwork.

Of the applications useful for the destruction of the fungoid diseases to which plants are subject, sulphate of copper washes seem to be the most generally useful. They are recommended for spraying over the plants in the cases of the potato fungus, the onion mildew, the apple scab, and the *Peronospora* of the vine, and for steeping the seed in the case of *Smut* and *Bunt* in wheat. Powdered sulphur also is recommended against Hop mildew, while freshly burnt quicklime and sulphur, also sulphate of iron, have been found useful in the case of the onion mildew, for which also sulphate of copper is recommended.

Indian Museum, Calcutta,
29th February 1892.

NOTES ON SCOLYTIDÆ.

By W. F. H. Blandford, F.E.S., F.Z.S.

[1] *Pityogenes scitus n. sp.*

This species is new to science: it is very closely allied to the European *Tomicus* (or *Pityogenes*) *chalcographus*, from which it can be separated only by careful comparison.

Pityogenes.—Bedel. Faune des coléoptères du bassin de la Seine. VI, p. 388. A genus formed to contain those species of *Tomicus* (as limited by Eichhoff, etc.) in which the prosternum has no intercoxal process, the anterior tibiæ are sublinear, and the apical depression of the Elytra is impunctate. The type is *P. chalcographus*.

P. scitus sp. nov. Mihi.—Sub-elongatus, nitidus, sub-glaber, nigro-piceus, antennis et pedibus ferrugineis; elytris ferrugineo-testaceis, basi et margine laterali (et apice in maribus sat maturis) infuscatis; thorace ante medium lateraliter coarctato, post medium impresso, antice fortiter exasperato, postice punctis fortibus, sparsisque notato, linea sub-elevata et plaga laterali laevibus; elytris tenuissime striato-punctatis, punctis versus apicem obsoletis, prope suturam profunde impressis et dentibus tribus in utroque depressionis latere armatis.

Long.; 1·7—2 mm.

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[1] This insect was originally sent to the Indian Museum, as attacking the *Shorea assamica* tree in Sibsagar, Assam (see Volume I, p. 42 of this serial). On Mr. Blandford's noticing, however, that other species of *Tomicus* and *Pityogenes*, in the modern limits of these genera, are only to be found in conifers, some small pieces of stick that were originally forwarded with the insects, were sent to the Royal Botanical Gardens, Sibpore, for further examination. Here they were kindly looked at by Dr. George King, who found that they do not belong to the *Shorea assamica* tree, but possibly to *Pinus khasya*, the sticks, however, not being sufficient for precise identification. The tree therefore that is attacked by *Pityogenes scitus* Bland., though not definitely ascertained, is no doubt one of the conifers. The figure shows the imago dorsal view, also much enlarged diagrams of the legs and antenna. The actual size of the insect is shown by the hair line.

Mas. Fronte convexa, rugulose punctata, linea media sub-elevata; dentibus elytrorum validis. *Femina* Fronte plana, tenuissime granulata, foveam profundam in vertice exhibente, non-nunquam supra os lateraliter impressa; dentibus elytrorum ad tubercula setigera reductis.

Hab.: *Doubtful.*

This species closely resembles *P. chalcographus*, but differs in the following points:—

The forehead in the female has three strong foveæ with a central space raised, smooth and dull, whereas in *P. chalcographus* the fovea is single and is much nearer the mouth, and the lateral foveæ do not occur.

The prothorax is generally similar to that of *P. chalcographus*, except that it is very slightly narrower anteriorly; the punctures on the posterior half are stronger, closer, and more rugose.

The interspaces are filled with excessively fine punctures, only visible under a high power, and much closer than the similar scattered punctures in *P. chalcographus*.

The elytra in the male are testaceous, strongly infuscate along the lateral margin, and for the whole of the apical declivity they are slightly narrower and flatter, the apical depression is shorter and more vertical, and the teeth are situated farther back, and closer to each other, and the anterior pair point directly backward instead of obliquely upwards, and their base is longer.

In the female the elytra are more testaceous yellow (in spirit specimens), sometimes with a distinct dark lateral border; they are slightly flatter and less shining, and the rows of punctures are not so distinct and regular as in *P. chalcographus*. Antennæ and legs as in the latter species.

[1] *Platydactylus sex-spinosus Motsch.*

This insect was first described from Ceylon by Motschoulsky as *Eccoptoplerus sex-spinosus;* Eichhoff then described it independently as *Xyleborus abnormis*, and subsequently noted its identity with Motschoulsky's species, pointing out that the latter genus was bad and founded on untenable characters, and ignoring Motschoulsky's specific name. In 1886 he founded a new genus *Platydactylus*, for *P. gracilipes* from the Moluccas, and then suggested that his *Xyleborus abnormis* may belong to this genus This I find to be correct. I prefer to retain Motschoul-

[1] Noticed in vol. I, p. 61, of this serial as destroying paddy (*Oryza sativa*) in Lower Burma by boring into the stalks.

Mr. Blandford writes that the male will probably prove to be smaller in size and somewhat different in structure from the female.

sky's specific name, as it has priority, and Eichhoff's is inappropriate when the insect is no longer retained as a Xyleborus.

Platydactylus.—Eichhoff. Notes from the Leyden Museum, VIII (1886), p. 25.

Head globose, sunk in thorax. Antennæ with five-jointed funiculus, and sub-tunicate club. Prothorax scabrous in front, without basal border. Tibiæ strongly flattened, spatulate, finely serrate externally, and grooved for reception of the tarsi. Three basal joints of hinder tarsi broad and flattened, somewhat trigonate.

The form of the hinder tarsi will distinguish this genus from any other Tomicidæ.

Platydactylus sex-spinosus.—Motschoulsky. Bull. de la Soc. des Naturalistes de Moscow, 1863, I, p. 515 (*Eccoptopterus sex-spinosus*) *Xyleborus abnormis* Eichhoff, Berl. Ent. Zeit., 1868, p. 282. Ratio Tomicinorum, p. 343.

Oblong, moderately shining, pitchy-black with gray pubescence. Head large and globose, forehead closely punctured and pubescent above mouth.

Thorax nearly globose, broader than long, base truncate, posterior angles rounded, sides and apex rounded, the latter strongly; above very convex with an obscure transverse elevation behind middle of disc, thinly pubescent with transverse rows of asperities in front, behind smooth, dull, appearing finely alutaceous under a high power, with scattered punctures.

Elytra narrower than thorax, one-third longer, narrowed from base to apex, base truncate, shoulders and sides rounded; above convex at base, thence sloped to apex forming an oblique depressed surface beginning before the middle of the elytra; closely and irregularly punctured, the punctures being coarser in the apical depression, which is lighter in colour, and the sides of which are each armed with three strong pointed spines. The upper one is the largest and placed about the middle of the elytra, the lower the smallest are close to the apex.

Anterior and middle coxæ and femora testaceous, tibiæ and tarsi pitchy; posterior legs pitchy except last tarsal joint. Joints of the posterior tarsi oblong, flattened; first joint larger than second or third joints.

Length, 2·5 mm.

Habitat: Ceylon, Burma.

NOTES ON COCOANUT PALM COCCIDÆ.

By W. M. Maskell, F.R.M.S.

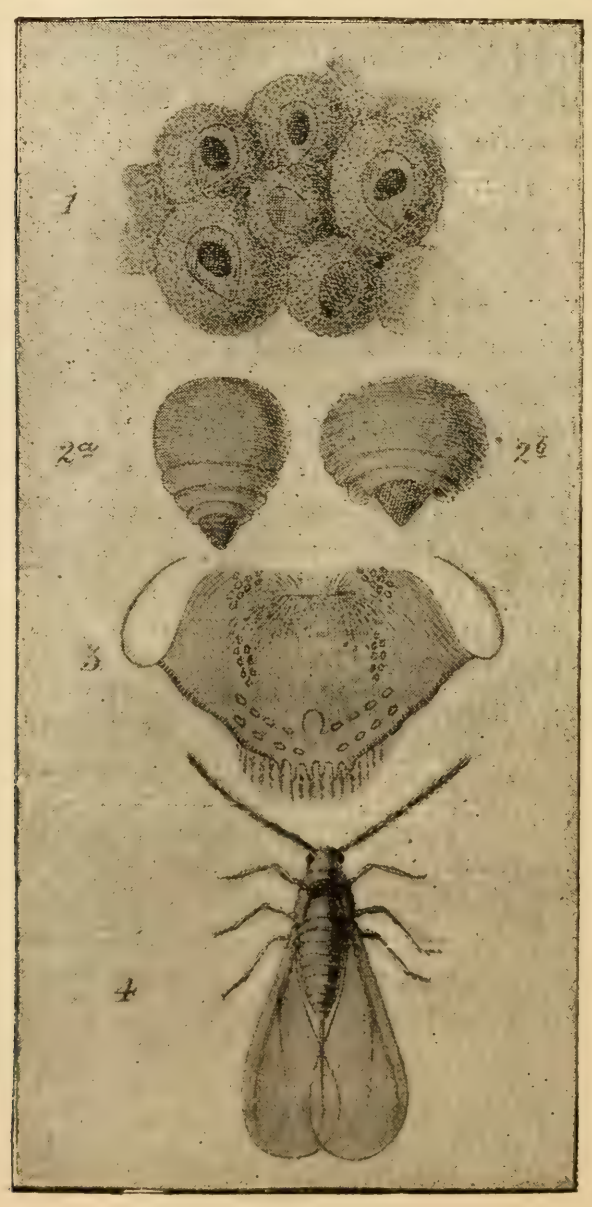
[The following insects attack cocoanut palms in the Laccadive Islands. For further particulars see page 7.—Ed.]

Dactylopius cocotis Maskell.

Transactions N. Z. Institute, 1889, Volume XXII, p. 149.

A variety of this species occurs on cocoanut palms in the Laccadive Islands, India. The differences from the type which inhabits Fiji are as follows :—The Indian insect is scarcely red in colour, inclining rather to yellow, and the antennæ have (at least frequently) only seven joints. The first point is very unimportant, and as to the second there are at present known six or seven species of Dactylopius in which the antennal joints vary from seven to eight. The marginal tufts of small hairs, the characters of the feet, the form of the larva, and other features, are similar in both Indian and Fijian specimens, and they may therefore be properly considered as specifically identical.

Aspidiotus destructor Signoret.



Essai sur les Cochenilles, p. 94: Annales de la Société entomologique de France, 1868, p. 120. Figs. 1—4.

Female puparium really round and white in colour, but being aggregated in masses on the leaf with very numerous yellow pellicles and much dust and fluff: the general appearance of the mass is brownish yellow: the secreted portion of the puparium is very thin, delicate and translucent: pellicles central, yellow, transparent.

Male puparium similar to that of the female and aggregated with it in the general mass, so that it is difficult to indicate any particular features, except of course that only a single pellicle is visible in it, the female puparium having as usual two.

Adult females yellow, darkening with age; length about one-fiftieth of an inch pegtop-shaped, shrivelling at gestation. Abdomen ending in six lobes, of which the two median are shorter and smaller than the next lobe at each side of them: between the lobes and for a short distance beyond on the margin, are a number of scaly serrated and forked hairs: four groups of spinnerets with from eight to ten orifices in each: many single dorsal spinnerets. The rostral setæ appear to be often excessively long.

Adult male brownish yellow, very small and delicate: length about one-sixtieth of an inch. Form normal. Antennæ of ten joints. The anal spike is rather long.

Habitat—on cocoanut, date, and other palm trees, and on *Goyaeries psidium*: Isle de la Réunion and Laccadive Islands, and probably elsewhere in the tropics. Dr. Signoret states that about 1868 the cocoanuts of Réunion were "threatened with total destruction" by this insect.

The proportionate smallness of the two median abdominal lobes in the female is a distinguishing character of the species. Dr. Signoret was not able to find a male amongst the specimens sent to him.

From the folded and closely pressed form of the cocoanut leaves which I have seen, I should imagine that it would be far from easy to proceed against *A. destructor* by ordinary methods of spraying: but I am not sufficiently acquainted with the habit of the trees to express a decided opinion, and there may possibly be facilities for other remedial measures.

Description of Figure.—1, aggregation of male and female puparia, male with one pellicle, female with two (the insects are removed); 2, adult females, *a* before gestation, *b* after gestation; 3, Pygidium of female (after Signoret); 4, adult male.

THE SILK-COTTON POD MOTH.

By F. Moore, F.Z.S.

[This insect was reared in the Museum from silk-cotton pods furnished by Mr. R. Blechynden of the Agri-Horticultural Society. The pods were found to be tunnelled by the caterpillars. They were received in the latter part of the cold weather, about the time that the silk-cotton pods ripen in Calcutta. Mr. Blechynden noticed that the crows paid a good deal of attention to the fallen pods, no doubt with a view of devouring the caterpillars they contained, and the extraordinary speed with which the caterpillars tunnelled into the earth when the pods were opened shows that they appreciate the fact that the crows are on the look-out to eat them up. The caterpillars constructed for themselves typical noctues cells of earth in the ground, for the protection of the pupæ, and the moths emerged in the following March, when the silk-cotton trees (? *Bombax malabaricum*) were in flower on the Calcutta Maidan. The insect therefore passes through but one generation in the year, and probably lays its eggs in the flowers or immature pods of the silk-cotton tree. The figure shows the male and female moths, and the pupa lying in the earthen cell that the caterpillar makes in the ground; all natural size.—Ed.]

Family Hadenidæ.

Genus Nov. Mudaria—Male.—Forewing elongata, narrow, apex rounded, exterior margin oblique and slightly convex; cilia scalloped; cell long, more than half the length of wing; first sub-costal branch emitted at three-fifths before end of the cell, second branch from close to end of cell; third from end of cell, trifid, the sixth (or upper radial) also from end of cell; discocellular very slender, outwardly recurved, the radial from near its lower end; two upper median branches from angles at lower end of the cell, the lower median at three-fifths before end of the cell; sub-median vein recurved. *Hind-wing* moderately short, apex rounded, exterior margin slightly convex, and very slightly scalloped; cell extending to half the length, broad; sub-costal vein curved near its base and touching the costal; two sub-costal branches emitted from end of the cell; discocellular outwardly oblique, radial from near its lower end; two upper median branches from a footstalk a little beyond end of the cell, lower median at about one-third before end of the cell; sub-median and internal vein straight. *Body* stout, abdomen extending beyond hind-wings, compactly scaled, thorax sub-crested at posterior end. *Antennæ* thick, whip-shaped; *head* prominent, the front furnished with a broad flat centrally-pointed black hard corneous piece, which projects slightly but visibly beyond the scales. *Palpi* short stout, porrect, not reaching the front, compactly squamose, third joint short, cylindrical, narrower than lower joints. *Legs* stout; fore-legs short; femora thickly clothed with long hairy scales; hind tibia with two pairs of prominent spurs. *Female.*—Antennæ as in male. Frontal corneous piece broader and projecting more prominently beyond the

scales. Palpi longer, extending beyond the front; third joint longer than in the male; legs similarly clothed.

Mudaria cornifrons.—Male. Upper side. *Fore-wing* ferruginous-gray, with numerous minute blackish scales; crossed by four black lines, each line being dilated at the costal end; the first line basal, sinuous, duplex, but indistinctly defined; the second line sub-basal, irregularly zigzag, duplex, the exterior being most prominent; the third line discal, recurved, sinuous, duplex, the points upon the veins, the interior line being most prominent; the fourth line sub-marginal, lanceolated, the points upon the veins; between the sub-basal and the discal line is a large, broad, longitudinally disposed, irregular constricted black lined mark, which extends above and below the cell; marginal cilial line with slightly defined black lunules; cilia slightly interlined with black. *Hind-wing* white, with a slender black marginal lunular line. *Body* dusky grey above, paler grey beneath; palpi and legs, dusky grey; antennæ dusky brown; front piece corneous, shining jet-black; proboscis long; tarsi with pale bands. Under side.—*Fore-wing* greyish-white, glossy; costal border and the exterior half slightly speckled with minute blackish scales. *Hind-wing* with the costal and apical borders also slightly speckled with similar blackish scales; a small slightly defined black speckled spot on middle of the discocellular veinlet.

Female.—Upper side. *Fore-wing* paler, more uniformly grey; speckled with black scales; transverse lines and the intermediate constricted mark as in the male; the posterior border and interspace between this mark and the sub-basal and discal line is, in some specimens only, thickly black speckled. *Hind-wing* very slightly grey, speckled along the costal

border, and with a few black scales disposed upon the lower sub-basal and the median veins, thus forming a series of incipient discal spots; marginal line blackish. Under side as in the male. *Body* palpi, and legs grey; tibia and tarsi with dusky grey bands; the jet-black corneous front-piece larger, broader, and more prominently projected than in male. Expanse of wings; ♂ $1\frac{5}{8}$, ♀ $1\frac{3}{8}$ to $1\frac{5}{8}$ inch.

Habitat—Calcutta.

A NEW GALL-MAKING APHID.

By G. B. Buckton, F.R.S.

(The galls, from which these insects were obtained, were furnished by Mr. C. F. Elliot, who found them on what was thought to be a variety of the *Pistacia terebinthus*, tree with aromatic leaves something the shape of those of the lilac. The trees were found in November 1891, growing in a forest in the dry bed of a broad stony ravine about 3,000 feet above sea-level, near Harnai, on the Sind-Peshin section of the North-Western Railway, Baluchistan. Almost every tree had a dozen or more of these galls towards the extremities of the branches. The galls were of every shape; some empty, some opening, and the flies swarming out; some still with the young insects closed up inside. The figure shows the winged insect with diagrams of its antenna and legs. The size of the specimens is indicated by hair lines. The gall which is also shown is half the actual size.—Ed.)

Late in December 1891, I received from the Indian Museum several pod-like vegetable excrescences, concerning which I have pleasure in making the following report:

These galls were of various sizes, some of them measuring as much as 4·5 inches or 11·5 centimetres in length, whilst others did not exceed the size of a small walnut. In width they were about 3·0 centimetres. The larger kinds had somewhat the appearance of contorted figs, more or less compressed and indented; but probably they were more cylindrical in form when fresh and green. Their prevailing colour was ferruginous-yellow or reddish, shading into yellow and greener tints. The surfaces were furrowed longitudinally with shallow streaks, with here and there small tears of resin of a turpentine consistence and odour.

The gall-like bodies seem to be formed directly from the leaf stalks of the trees, and not from the leaves. Whilst some of these excrescences were pyriform, others had a singular contorted shape and were twisted like a cork-screw. The galls terminate at their summits in a horny point, which in the five specimens examined were imperforate.

When cut across, they showed hard and woody walls, varying in thickness from that of card-board to the thickness of pasteboard of perhaps 1·5 millimetres. Each had but a single cavity, without partitions; and in some cases the outer walls were perforated by one or two small round holes about the size of a large shot.

In the largest specimen, a rent was found from which the winged insect had chiefly escaped.

The contents of these chambers consisted of a *débris* of dead insects, winged and apterous, mixed up with a quantity of fibrous substance and excrementatious matter almost insoluble in water. To the naked eye the mass was of a greenish-grey, mixed up with wings and legs forming a tangled heap.

The microscope showed these insects to belong to the Aphindinæ,

and to the group of Pemphiginæ, which are known to produce pseudo-galls by setting up irritation on the leaves or bark of various trees.

As this Pemphigus differ in several respects from any hitherto described from Europe or America, I add a diagnosis of the winged female, remarking that some Indian entomologist may usefully describe the colours, if they show such, from living specimens.

Pemphigus edificator, Buckton.

Imago, wholly black. Head small, furnished with normally formed eyes and the usual supplementary eyelet antennæ about half the length of the body, seven jointed, counting the terminal process as a joint. Third and sixth joints the longest, and apparently not tuberculated. Notum and pronotum broad. Abdomen ringed and tapering to a rounded cauda. Nectaries not visible. Legs black; the hinder pair hirsute. Tarsus, two-jointed with claws. Upper wings about twice the length of the body and normally folded. Costal edge strong, with a broad black cubital vein, ending beyond the middle of the costa with a broadly banded black stigma, having an internal dark cell. Stigmatic vein long and curved. Second vein short and disconnected from the cubitus, like that of Schizoneura. Third vein joined to the cubitus, and widely forked close to its insertion.

Lower wing small and delicate; with a cubitus twice forked, and complete to the margin.

Mr. Elliot found these pod-like galls on the twigs of Pistacia grow-

ing in the dry bed of a broad stony ravine about 3,000 feet above sea-level near Harnai in the Sind-Peshin section of the North-Western Railway. "Almost every tree had a dozen or more of these galls towards the extremities of the branches. They were in every stage; some empty, some opening, and the flies swarming out"; some still with the immature insects enclosed.

The galls which I examined in December contained only a few pupæ and larvæ. The grey mass before noted is nearly insoluble in water, but nevertheless it had a soapy flavour on the tongue.

Two of the excrescences contained also the caterpillar of some lepidopterous insect, each entangled in its own web.

They were quite lively and fat, about three-quarters of an inch long, and did not appear famished, although they cannot have eaten green food for many previous weeks. It is not very likely that they consumed the aphidis imprisoned in the galls.

In conclusion, I may note that the European *Pemphigus cornicularius* of Pusserini constructs a long bean-shaped gall with a pointed top. It has been figured by M. L. Courchet in "Etude sur les Galles produites par les Aphidiens," Montpellier 1879, see part 1, figure 4. He says this structure does not exceed in size that of a haricot-bean. Figures also are given in this same memoir of the antinnæ and the wings. In all these particulars *P. cornicularius* differs from the Indian *Pemphigus*, although both feed on different species of Pistacia, and have a close affinity.

HASLEMERE.

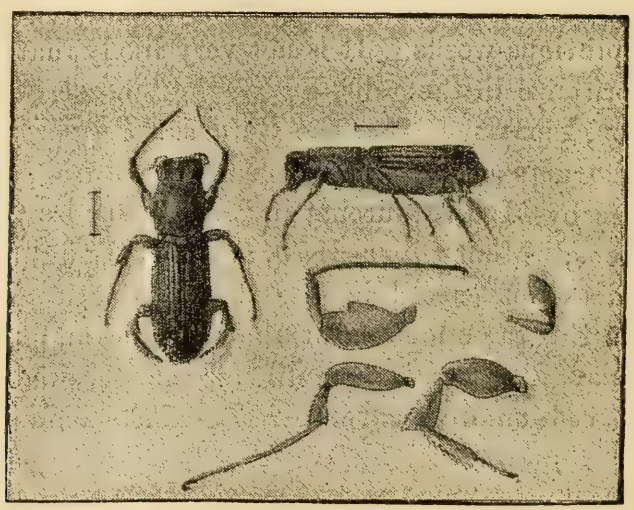
16 January 1892.

A NEW WOOD BORER.

By Oliver E. Janson, F.E.S.

[The specimens from which this species is described were said to have been found attacking oak stumps in Deoband, North-Western Provinces, in December 1881. They are referred to the Coleopterous Family Scolytidæ, sub-Family Platypides.—Ed.]

Diapus, impressus n. sp.—Rufo-brunneus, elytris flavo-testaceis, apice rufo-brunneis, antennis pedibusque flavis. Capite parce punctato, vertice tri-carinato, carinis nitidis, prothorace oblongo, lateribus emarginatis, elytris subtiliter punctato-striatis, interstitiis duabus suturalibus magis elevatis. Long. 3½—4 millimetres.



♂ Clypeo utrinque profunde impresso, elytris apice truncatis inermis.

♀ Clypeo punctato, elytris apice quinque-spinosis.

Deoband, North-Western Provinces, India.

Red-brown, shining, basal margin of the thorax and the elytra brownish yellow, apical portion of the latter red-brown; legs and antennæ pale yellow; the knees brownish. Head dull, sparsely punctured, three carinæ on the vertex, and one on each side behind the eyes shining; the clypeus, in the male, occupied by two large deep impressions separated by a narrow median carina and margined at the base by an obtuse bi-sinuous carina; in the female sub-convex, coarsely punctured, with a feeble median carina; antennæ with the scape broadly pyriform. Thorax oblong, strongly emarginate at the sides before the middle, the basal margin bi-sinuous, a row of hirsute punctures close to the anterior margin, the base finely and closely punctured and with a slight median line. Elytra punctate-striate, the second stria from the suture and the outer marginal one broader and more strongly punctured, the first and second interstices from the suture strongly raised, the fourth slightly convex; the apex coarsely punctured, sub-truncate and unarmed in the

male, in the female with five acute apical spines. Abdomen densely pubescent at the apex in the male, in the female concave and rugulose. Anterior tibiæ crenulate on the outer side, the tarsi very slender and longer than the femora and tibiæ together. Posterior tibiæ triangular, the first joint of the tarsi rather longer than the tibiæ, broad, flattened, and ciliate, the remaining joints slender and together about half the length of the first.

Most nearly allied to *D. molossus* Chap. (Mon. Platypides, p. 333), but in the male of that species (the only sex described) the clypeus is densely pubescent and without impressions, the scape of the antennæ is linear instead of pyriform, and the elytra have the interstices punctured and are uni-colorous, it is also rather smaller than the present species. The armature at the apex of the elytra of the female is very similar to *D. quinque-spinosus* Chap.

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